Institute of Engineering and Technology

Department of Mechanical Engineering

Handbook
for
B. Tech ME (Batch 2018-22)

CONTENTS

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Apply their technical knowledge, complex problem solving and research skills in professional practice

PEO2: Continue their intellectual development through critical thinking, self-study, apprenticeship, higher education, professional development courses, as well as participation in research groups and professional networks

PEO3: Serve as ambassadors for engineering and sustainability by exhibiting high professional standards with a deep sense of civic responsibility.

PEO4: Effectively communicate about technical and related issues.

PEO5: Embrace the roles of team members and leaders in their careers.

PROGRAM OUTCOMES (POs)

PO1 **Life-long learning:** Demonstrate inquisitiveness, open mindedness, and the ability to engage in independent and life-long learning in the broadest context of technological, organizational, economic, and societal changes.

PO2 **Citizenship, Sustainability, and Professional ethics**

2a: Demonstrate knowledge of constitutional values of liberty, equity, justice, and fraternity with an understanding of the impact of the engineering solutions in societal and environmental contexts as well as a sense of responsibility for sustainable development.

2b: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, cultural, and environmental issues and the consequent responsibilities relevant to professional engineering practice.

2c: Demonstrate commitment for professional integrity and excellence and respect for ethics, responsibilities and norms as prescribed for the engineering practice.

PO3 **Engineering knowledge and Modern tool usage**

3a: Demonstrate a clear conceptual understanding of the fundamentals of engineering specialization and cognitive flexibility to appropriately 'transfer' what has been learned in a context, to different situations.

3b: Apply engineering thinking, computational thinking, and the knowledge of mathematics, natural and social sciences, engineering fundamentals, information technology, engineering specialization, and engineering management to the solution of complex engineering problems.

3c: Create, select, modify, and apply appropriate techniques, best practices, standards, resources, and modern engineering and IT tools including prediction and modeling to engineering and social activities.

PO4 **Complex problem solving, Design and Research**

4a: Identify, formulate, review research literature, and analyze complex engineering problems to arrive at substantiated conclusions using critical thinking along with principles of mathematics, computing, engineering as well as natural and social sciences.

4b: Use systems thinking and reflection to identify and consider underlying structures, patterns, volatility, uncertainties, complexities, ambiguities, complications, and risks to design and develop engineering solutions for complex problems to meet the specified and anticipated needs with appropriate concern for constraints, performance, sustainability, and professional ethics.

4c: Use research-based knowledge and research methods including design of experiments, simulation, analysis and interpretation of data, and synthesis of the information to evaluate and improve the engineering solutions and practice.

PO5 **Individual & teamwork and Engineering management**

5a: Ability to work effectively as an individual and as a team member or a leader in diverse and distributed teams, and in multidisciplinary settings.

5b: Ability to apply engineering management principles to one's own and team's work to manage engineering projects and operations and in multidisciplinary environment.

PO6 **Communication:** Ability to communicate effectively on complex engineering and technology activities, situations, problems, and solutions using verbal, textual, and pictorial elements with the colleagues, engineering community, users, clients, policy

makers, and society at large with intellectual honesty, clarity, empathy, and compassion.

PO7 Innovation and entrepreneurship:

7a: Demonstrate enthusiasm and understanding to identify opportunities and translate research in engineering and other disciplines to conceive and design innovative engineering solutions for business, industry, and societal problems.

7b: Demonstrate enthusiasm and understanding to conceive and plan technology based new ventures either as independent start-up businesses or within existing corporate structures.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1. Conceive, design, implement and manage mechanical systems, components, and processes by using principles of machine design, production engineering, thermal engineering, computing, automation, sustainability and contemporary materials and tools.

PSO2. Serve in fields of engineering services, manufacturing, automobile, energy, EPC and mechatronics.

JK Lakshmipat University, Jaipur
Institute of Engineering and Technology
Department of Mechanical Engineering
Course Structure for the B. Tech (Batch 2018-2022)

Semester	Courses								(L T P S) Credits	Hrs/ Week
I	Calculus and Applied Mechanics	Design and Prototyping	The Power of Story telling							
	BES101	BES102	CCT101							
	(6 2 0) 6	(6 2 0)6	(2 1 0)3						15	19
II	Computational Data Analysis	Fundamentals of Automation Engineering	Fundamentals of Critical Thinking	Experimental Physics	Environmental Studies	Articulation and Elocution				
	BES201	BES202	CCT201	PH202	ID201	CCT202				
	(10 2 0) 10	(6 2 0) 6	(2 0 0)2	(1 0 4)3	(2 0 0) 1	(6 Hrs.)			22	29
III	Materials Engineering	Computational Engineering Analysis-I	Engineering Measurements and Machines	Engineering Thermodynamics	Perspectives on Contemporary Issues	Programing Week	Engineering Drawing			
	ME1101	ES1106	ES1107	ME1102	CC1103	CS1104	ME1103			
	(3 0 2) 4	(3 1 2) 5	(3 0 4) 5	(3 0 2) 4	2	2	(0 0 2)1		23	25
IV	Transport Phenomena	Strength of Materials and Analysis	Computational Engineering Analysis-II	Production Technology-I	Communication and Identity	Introduction to Design	Mechanical Engineering CAD lab	Computer Aided Modeling and Simulation		
	ME1104	ME1105	ES1109	ME1106	CC1104	IL1102	ME1107	ME1206		
	(3 0 2) 4	(3 0 2) 4	(3 1 2) 5	(3 0 4) 5	2	2	(0 0 2) 1	(1 0 2) 2	25	28
	Practice School - I (PS 1101) – (4 to 6 Weeks Duration)								4	
V	Theory of Machine	Production Technology- II	Mechatronics	Infrastructure and Urban Planning	Understanding and Managing Conflict	Introduction to Internet of Things				
	ME1108	ME1109	ME1207	CE1212	CC1105	EE1111				
	(3 0 2) 4	(3 0 2) 4	(3 0 2) 4	(3 0 2)4	2	2			20	22
VI	Design of Machine Elements	Computer Aided Product Design and Manufacturing	Automobile Engineering	Computational Fluid Dynamics	Critical Thinking for Decisions at Workplace	Emerging Tech Week	Automation Projects			
	ME1110	ME1210	ME1111	ME1211	CC1106		PR1101			
	(3 0 2) 4	(3 0 2) 4	(3 0 2)4	(3 0 2)4	2	2	2		22	19-24
VII*	DE-4	DE-5	DE-6	OE-3	Minor Project (PR1103)					
	4	4	4	4	4				20	20
VIII*	Practice School - II /Entrepreneurial Project/Research Project/Semester at a partner University								16	

INDEX

B. Tech (ME) (Batch: 2018-2022)

Course Title and Code: Calculus and Applied Mechanics BES101	
Hours per Week	**L-T-P: 6-2-0**
Credits	**6**
Students who can take	**B. Tech Semester-II (Compulsory)**

Course Objective:

This course introduces the basic elements of calculus and mechanics through some engineering projects. The application of multivariable calculus in civil and mechanical engineering is also highlighted. This course will equip students with essential domain knowledge of calculus and applied mechanics in solving basic engineering problems.

On successful completion of this course, the student should be able to:

1. apply analytical techniques to determine forces in structures
2. use commercial software (STAAD Pro.) to simulate a structure/frame and determine force in the members
3. model physical phenomena using calculus and solve using appropriate method
4. apply Newton's laws of motion and understand the concepts of dynamics concepts (force, momentum, work and energy)
5. interpret the geometrical significance of differential and integral calculus
6. solve problems of vector differentiation and integration
7. calculate the buoyant forces of a objects with various shape and carryout the stability analysis
8. apply the concept of partial differentiation to solve optimization problems

Sr. No	**Specifications**	**Marks**
1	Attendance	--
2	Assignment	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	30
8	Report-I	--
9	Report-II	--
10	Report-III	--
11	Project-I	15
12	Project-II	15
13	Project-III	--
14	Lab Evaluation-I	--
15	Lab Evaluation-II	--
16	Course Portfolio	--
	Total (100)	**100**
Evaluation policy for retest		
1	Theory Exam-III	30

Syllabus:

Vectors Algebra: basics of vector algebra, resultant vector, Application of vector equilibrium on structures.

Force systems basic concepts, equilibrium of system of forces, free body diagrams, equations of equilibrium of coplanar systems, structures (trusses), analysis of structures, method of joints, method of section, friction, virtual work, work energy principle, kinematics and kinetics of particle, impulse-momentum (linear, angular); impact, projectile motion.

Function of several variables, functions of one and several variables, partial differentiation, maxima-minima.

Vector Differentiation: Vector functions and derivatives, Arc length and unit tangent vector, Curvature and unit normal vector, Directional derivative and gradient vectors, Tangent plane, Divergence and curl of a vector field

Integral Calculus, area under curve, arc length, double integral, change of order and triple integrals, surface and volume integrals, solids of revolution, moment of inertia, floatation, buoyancy, centroid

Vector Integration: Line integral, flux, work done, circulation, path independence, potential function and conservative fields, Surface area and surface integral, Green's theorem in the plane, Stoke's theorem, Divergence theorem

Text Books:

1. M.D. Weir and J. Hass, Thomas, Calculus, Pearson, India, 2016.
2. R.C Hibbeler, Engineering Mechanics, Pearson India, 2010.

Reference Books:

1. Goldstein et. al., Calculus and Its Applications, Pearson, India, 2018.
2. SS Bhavikatti,Engineering Mechanics, New Age International Publishers, 2019.
3. Beer and Johnston, Vector mechanicsfor engineers, McGraw Hill Education, 2009.
4. S Timoshenko, Engineering Mechanics, McGraw Hill Education, 2017.
5. Erwin Kreyszig,Advanced Engineering Mathematics, Wiley, India, 2013.
6. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, New Delhi, India, 2015.

Course Title and Code: Design and Prototyping (BES102)		
Course Description The objective of this course is to open the students to learn free and lateral thinking and initiate creative problem-solving. The course will encourage students to learn through hands-on experience and break away from traditional learning methods. This course will initiate by introducing the role of design thinking in process of designing a product and it will emphasize the role of research in the design process. The course will run by providing the operational skills to conduct design research and how to use the research insights for creating a product. Students will also get the exposure to manufacturing techniques such as casting, forging, joining, laser cutting, 3D printing etc. In a nutshell, the course will move around the user-centric approach of design research and methods for working out an appropriate solution for a problem space.		
Prerequisites		**None**
Hours per Week		**L-T-P: 6-2-0 /In Class-Out Class: 6-12**
Credits		**6**
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	10
03	Class Participation	20
04	Quiz	05
05	Theory Exam	Nil
06	Theory Exam	Nil
07	Theory Exam	Nil
08	Report-1	10
09	Report-2	10
10	Report-3	10
11	Project -1	15
12	Project -2	15
13	Project -3	Nil
14	Lab Evaluation	Nil
15	Lab Evaluation	Nil
16	Course portfolio	05
	Total (100)	**100**

Syllabus

Basics engineering drawing with AutoCAD, Fundamental manufacturing processes including metal joining, metal cutting, additive manufacturing, laser cutting, casting, sheet metal working etc.

Basic Design cycle, project definition, vision in product designing, base of pyramid model, context mapping, mind mapping, Life cycle analysis, process tree, SWOT analysis, VRIO analysis, perpetual mapping, Fish trap model, SCAMPER, WWWWWH, PreMo, C-Box, vALUE, Design Drawing, TecDoc.

Reference / Text Books

1. “The Design of Everyday Things” by Donald A. Norman

The Power of Storytelling
Course Code: CCT101
Credit: 3
L-T-P: 2-1-0

Course Description:
This course gets students started on the journey of storytelling by observing the world and themselves and weaving a narrative. At the end of this course the students will be able to observe, think, create and narrate their stories in an effective manner.

Syllabus:
Concept of a Story- Build common understanding about the course, Introduction of the course and the concept of stories; How Stories Begin- Source of stories in our lives; Story Mapping- Introduction of Story Mapping ,Elements of Story Mapping, Use of elements in creating stories; Story Boarding- Introduction of Story Boarding, How story Boarding is used, Use of Story Boarding in creating stories; Identifying Different Narratives- Everyone and everything has a story, How different stories impact us; Power of Observation - Introduction of sensorium, How sensorium help us to create a story; The Art of Listening- Why listening, Active and passive listening, Be an active listener ; Creating Stories- Detailed practice of different importance components of storytelling- i. Delivery – Overcome stage fear, work on body language, ii. Content – Create story, Edit, iii. Voice - Voice modulation, enunciation, pronunciation

Evaluation Scheme:

Sr. No	Specifications	Marks
01	Attendance	10
02	Assignment	70
03	Class Participation	20
	Total (100)	**100**

References for Reading:

1. Unleash the Power of Storytelling: Win Hearts, Change Minds, Get Results, Author: Rob Biesenbach, Publisher: Eastlawn Media (19 February 2018)
2. Story worthy: Engage, Teach, Persuade, and Change Your Life through the Power of Storytelling Author: Mathew Dicks, Publisher: Publisher: New World Library - New World Library - New World Library (15 May 2018)

Course Title: Computational Data Analysis (BES201)

Course Description: This course introduces computational analysis of data based on Linear Algebra Principles and Statistics. The computational analysis will include learning and utilizing Python as a programming language. This course will lead to a technical project that will include learnings from the course duration.

Learning Outcome

After course completion, the student will be able to

1. Write Simple Python programs using Various Datatypes, Control Structures, Decision Statements, Libraries, Functions (M1)
2. Develop Python programs using Classes and Objects, File Handling, Exception Handling, etc. (M2)
3. Develop Programs for Analyzing and interpreting Complex situations in various domains including sustainable development by combining various Linear Algebra, Statistics and Other Problem Solving Techniques (M3)
4. Model Complex systems as Linear simultaneous equations and analyze the same using Matrix methods (M1)
5. Model Data as matrices and Find Eigen Values and Eigen Vectors and Apply the same for problem solving, e.g., ranking and performance analysis (M1)
6. Perform Support Vector Decomposition on Matrices (M1)
7. Summarize and Visualize different datasets (M2)
8. Analyze and interpret different datasets using Discrete and Continuous Probability Distributions and Apply the same for problem solving, e.g., Goodness of Fit (M2)
9. Formulate and validate parametric hypothesis with reference to different datasets (M2)
10. Apply correlation, regression, least square method and time series analysis for modeling, analysis, interpretation and forecasting (M2)

Teaching Scheme and Credits

Hrs. per Week		Credits	Duration in Weeks
In Class	Out Class	10	12
10	20		

Evaluation Scheme

Sr. No	Specifications	Weightage (in percentage)
01	Attendance	Nil
02	Assignment	16
03	Class Participation	14
04	Quiz	Nil
05	Theory Exam	10
06	Theory Exam	10
07	Theory Exam	Nil
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	10

12	Project -2	10
13	Project -3	30
14	Lab Evaluation	Nil
15	Lab Evaluation	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus

Introduction to Algorithms, Hardware Overview, Python as a Tool, Installing Python and Writing a Program, Variables & Expressions, Decision Statements, How to Debug? Control Structures: Loops & Iterations, Linear Data Structure: String, List, Tuple, Data Dictionary and Set, Python Library (Pandas, Numpy, PyPlot), Functions, Classes & Objects, Exception Handling, Working with Files

Matrix Operations, Eliminations, Matrix Inversion, Transformation, Solution of Linear, Simultaneous Equation, Eigen Values & Eigen Vectors, Linear Transformation, Linear Combination, Vector Spaces and Subspaces, Singular Vector Decomposition(SVD) and Principal Component Analysis (PCA)

Probability, Baye's Rule, Sampling, Data Processing and Pre-processing, Random Variable, Discrete & Continuous Distribution, Hypothesis Formulation, Test of Hypothesis, ANOVA, Correlation, Curve Fitting, Regression, Time Series Analysis, Forecasting, Reliability, Quality Control

Reference Books

1. Allen B. Downey. Think Python. Green Tea Press, Massachusetts, USA.
2. Kenneth Hoffman and Ray Kunze. Linear Algebra. PHI Learning Private Limited, 2nd Edition, 2012.
3. Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, 4th edition, 2009.
4. Allen B. Downey. Think Stats. Green Tea Press, Massachusetts, USA.
5. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley & Sons, Inc., 3rd Edition (2004).
6. Rishard A. Johnson, Miller and Freund's probability and Statistics for Engineers, PHI

Fundamentals of Automation Engineering BES202
Credit: 6; Contact Hours – 2 Hrs/week

Course Description: This course aims at building key technical competencies needed by automation engineers. It is focused on basic knowledge and critical understanding of different technologies in the design and maintenance of automation systems.

Learning Outcomes
On successful completion of this course, the students should be able to:

1. propose and implement a complete solution for a simple automation problem, including power supply, actuator, sensor, sensitized with energy usage and effects on environment.
2. evaluate the benefits and challenges of automation technologies
3. explain the importance of adopting suitable engineering standards for automation projects
4. use basic management practices for developing automation projects

Unit 1 Introduction to Electrical Engineering – U1

1) Analyze electrical circuits using network theorems
2) Measure electrical parameters of passive as well as active electrical components
3) Design rectifier circuit using semiconductor devices.
4) Design filters for power conditioning.
5) Design and build Printed Circuit Boards.
6) Use electrical safety practices while working on electrical projects.

Unit 2 Introduction to Automation Engineering and Control Systems – U2

1) Design and implement open-loop control system
2) Formulate mathematical models for basic mechanical, electro-mechanical and fluid systems
3) Conduct analysis of dynamic control system.
4) identify the need for feedback in control systems

Unit 3 Introduction to Digital Circuits and Embedded Systems – U3

1) Evaluate and simplify Boolean functions and design the minimized logic using logic gates.
2) Design basic combinational and sequential circuits with minimum complexity
3) Implement various logic functions using software programming with micro controller, to make optimal utilization of resources.
4) Identify the key features of embedded systems in terms of hardware and software
5) Interface sensors and design low power embedded systems projects using microcontroller

Evaluation Scheme

Sr. No	**Specifications**	Regular student(s)
01	Attendance	Nil
02	Assignment (04)	20
03	Class Participation & Attendance	5
04	Quizzes	5

05	Theory Exam I	10
06	Theory Exam II	Nil
07	Theory Exam III	20
08	Report -I	Included with Project
09	Report-II	Included with Project
10	Report-III	Included with Project
11	Project -I	Included with Project
12	Project -II	10
13	Project -III	10
14	Lab Evaluation I (End Term)	20
15	Lab Evaluation II	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus:

- Electric Circuit Analysis: Application of network Theorems, Laplace Transform, Application of network Theorems. Laplace Transform for solving equations for reactive components. Concept of Phasors and Phasor diagrams, power factor calculations. Smart energy meter. Single phase and three phase wiring and balancing of loads.
- Transformers and power supply(rectifiers). Safety in handling Electrical equipment.

- Working principle of DC Motors, PWM for speed control, Principle of working of Servomotors, Introduction to control system: open and closed loops. Block diagrams, PID control of servomotors, Mechanical models. Actuators, DC motor. PWM. DC servomotor, Brushless motors - AC motor, Introduction to Feedback Controllers

- Digital circuits for automation: Boolean Algebra, Karnaugh map, Logic gates, Decoders and Multiplexers, Displays, Counters and Timers (555) and applications. Architecture of ATMega328 (concepts on ALU, memory, ports). Implementing logical functions using microcontroller programs.

- Familiarization with standards on Instrumentation and Measurements. Significance of SCADA and HMI in automation projects. Working principle of Sensors and their interfacing to microcontrollers Movement detection, gyro motors, vision, sonar, laser, tactile, calibration of few analog sensors.

Textbooks:

1. WH Hayt, J E Kemmerly, SM Durbin, Engineering Circuit Analysis, Eight Edition, 2013, Mc. Graw Hill, ISBN 978-0-07-352957-8.
2. M. Morris Mano, Digital Logic and Computer Design, 1st Edition, 2016, Pearson India Publication, ISBN: 9789332542525.
3. S Palani, Control Systems Engineering, 2nd edition,2 August, Mc. Graw Hill Education, ISBN-10: 0070671931.

Reference Books:

1. B. L. Theraja,A. K. Theraja, “A Textbook of Electrical Technology, Volume I: Basic Electrical
2. Engineering”, S. Chand Publication.
3. C. L. Wadhwa, “Basic Electrical Engineering”, New Age Int. (P) Limited, Publishers.
4. Giorgio Rizzon, “Fundamentals of Electrical Engineering”, McGraw-Hill Higher Education.
5. Charles A. Gross Thaddeus A. Roppel, “Fundamentals of Electrical Engineering”, CRC press.
6. B. K. Ghosh, Ning Xi, T. J. Tarn, “Control in Robotics and Automation: Sensor- Based Integration” Academic Press.
7. Boris J. Lurie, Paul J. Enright, “Classical Feedback Control” Marcel Dekker Inc. publication.
8. Digital Logic and Computer Design Fundamental by Morris Mano,Pearson Publication, 5th Edition.
9. Programming and Customizing the AVR Microcontroller by Dhananjay Gadre, 1st Edition, Mc Graw Hill Publication, ISBN-13: 978-0071346665
10. Computer based industrial control, Kant, Krishna, New Delhi: PHI, 2013, c2010, ISBN-9788120339880
11. Modern control system, Richard C Dorf and Robert H Bishop, New Delhi Pearson c2008, ISBN: 9788131718872

Fundamentals of Critical Thinking
Course Code: CCT201
Credit: 2
L-T-P: 2-0-0

Course Description:
This course will train students to observe and think from multiple perspectives, examine information and knowledge critically, analyze skillfully, evaluate and take a well-reasoned position.

Learning Outcomes:
Students will be able to

- Formulate intelligent questions
- Evaluate information and evidence for correctness, consistency, and relevance
- Compose well-structured and well-reasoned arguments
- Evaluate an argument for consistency, logical validity, coherence, breadth and width, and relevance.

Course Content:

- **Importance of questioning**-The key to critical thinking is the ability to formulate intelligent questions. Students will be able to create, improve and prioritize their questions. They will be able to use different types of question by using Bloom's taxonomy to understand the root of any situation, problem or subject.
- **Examine data critically**-Students will be able to filter information, separate fact from opinion, identify cognitive biases and become aware of the ladder of inference. They will also be taught to conduct responsible research and basics of bibliography and citation.
- **Construct and reconstruct argument**- Students will be taught to construct arguments with sound reasoning. They will be able to support their claims and opinions with compelling data and facts, and present well-informed arguments.
- **Application of Critical Thinking**- Students will learn to use critical thinking in workplace and business scenarios, case studies and write with a critical voice. They will learn to critique the information they gather.

Evaluation Scheme:

Sr. No	Specifications	Weightage (in percentage)
01	Attendance	10
02	Assignments (4)	35
03	Class Participation	10
04	Theory Exam	25
05	Report-1	10
06	Project -1	10
	Total (100)	**100**

References for Readings:

1. Fisher, A. (2011). Critical thinking: An introduction. Cambridge University Press.
2. Fisher, A., & Scriven, M. (1997). Critical thinking its definition and assessment. Centre for research in Critical Thinking.

3. Dobelli, R. (2013). The art of thinking clearly: better thinking, better decisions. Hachette UK.
4. Budden, L. (2007). Critical Thinking Skills: Developing Effective Analysis and Argument. Contemporary Nurse, 25(1-2), 174-175.

Articulation and Elocution
Course Code: CCT202
Credit: Audit Course
Total Number of Contact Hours: 6 Hrs.

Learning Outcomes:

On successful completion of this course, the students should be able to:

- Use richer vocabulary in their communication appropriate to the context.
- Use appropriate grammar, vocabulary and style which are essential to professional-level reading, writing, speaking, listening, and editing.
- Apply various strategies to make the speeches/ conversation interesting and captivating.
- Using the sentence structure effectively and connect ideas logically within a paragraph.
- Write descriptions on various objects and topics.

Course Outline (Tentative Session Plan):

Sessions	Content	Activities
1	Listening	• To inculcate the skills of content prediction, inference and discourse coherence. • Acquire proficiency in Prosodic Features (Pronunciation, enunciation, pitch, intonation/voice modulation)
2	Ideation and Expression	• Proving situation/context to trigger thinking process • Just Minutes • Role Play/ Situational Dialogues • (Oral Narration) Describing people, places, events and things
3	Reading	• Distinguishing the main idea and supporting ideas • Transcoding information to diagrammatic display, recognizing indicators in discourse, understanding conceptual meaning and summarizing. • Reading and writing skills will be targeted simultaneously.
4.	Writing	• To throw some light on the features of the connected speech/ composition such as use transitional words, connectives, etc. • To explain various strategies for the organization of ideas such as introduction, development, transition, conclusion, emphasis, explanation and anticipation.
5	Vocabulary Building	• Introducing Idioms, Proverbs, Phrasal verbs and asking them to use the same. • Connotative and denotative meaning of the words.
6	Collecting and Analyzing Information	• Assigning students to read books, newspapers, magazines and stories to learn from, assess and improve analytical ability. • Allotment will be done before the class.

Evaluation Scheme:

Sr. No.	Evaluation Component	Weightage (%)
1	Attendance	10
2	Assignment(s)	30
3	Class Participation	10
4	Quiz	10
5	Project-I	15
6	Lab Evaluation-I	25
	Total (100)	100

References for Reading:

1. Sanjay Kumar & Pushp Lata "Communication Skills". New Delhi: Oxford University Press, 2011.
2. M Ashraf Rizvi "Effective Technical Communication". Chennai, McGraw Hill Education, 2018

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ID 201	Environmental Studies	2	0	0	0	2

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)				
Mid Term Test – I	Mid Term Test – II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks	Mid Term Test - I	End Term Test	Class Participation	Additional Continuous Evaluation*	Total Marks
20	20	40	20	100	-	-	-	-	-

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Course Syllabi (Theory):

- Understanding environment, The global crisis, Basic Concepts
- Forest and Grassland ecosystems, Desert Ecosystems, Aquatic Ecosystems
- Introduction to Biodiversity, Biodiversity Conservation
- Water Resources, Energy Resources, Forest Resources
- Land, Food, and Mineral Resources
- Air and Noise Pollution, Water, Soil, and Marine Pollution
- Solid Waste Management and Disaster Management
- Population Growth, Environment and Human Health, Sustainable Development
- Global Warming, Acid Rain, and Ozone Depletion
- Different types of laws and regulations

Text Books:

1. Rajagopalan, R., "Environmental Studies: From Crisis to Cure", Oxford University Press, New Delhi, 2e, 2011.

Reference Books:

1. Ranjit Daniels & J. Krishnaswamy "Environmental Studies", Wiley India.
2. Davis & Cornwell "Environmental Engineering", Mc-Graw Hill.

Course Title and Code: Experimental Physics: PH202	
Hours per Week	**L-T-P: 1-0-4**
Credits	**3**

Course Objective

This course is designed to familiarize the student with the fundamental concepts of different phenomenon related with optics, electromagnetism, and modern physics. This course will expose the students with experimental methods of physics and integrates theoretical knowledge and concepts to practical experience.

Learning Outcomes:

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

1. analyze ferromagnetic properties of any magnetic material and differentiate Soft and hard materials.
2. analyze thermoelectric effect of metal junctions due to temperature difference.
3. analyze nuclear radiation with respect to distance and thickness of absorbing media.
4. measure electrical properties e.g. specific resistance, high resistance, dielectric constant, time constant of various electrical components.
5. measure resolving power of telescope, dispersive power of prism, specific rotation of optically active medium, e.g., sugar solution, wavelength of radiation, height of objects, coherent length and coherent time of Lasers.
6. measure numerical aperture of Optical Fibre and classify its structures.
7. use Schroedinger equation and quantum mechanical approach to analyze behavior of the quantum particle under different potentials.

Prerequisites		**Knowledge of Basic Science**
Sr. No	**Specifications**	**Marks**
01	Attendance	5
02	Assignment	Nil
03	Class Participation	5
04	Quiz	10
05	Theory Exam	Nil
06	Theory Exam	Nil
07	Theory Exam	20
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	10
11	Project -1	Nil
12	Project -2	Nil
13	Project -3	10
14	Lab Evaluation-1	20
15	Lab Evaluation-2	20
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus

1. To determine the ferromagnetic constants retentivity, permeability and susceptibility by tracing I-H curve using C.R.O.
   Description: CRO, ferromagnetic property of materials, retentivity, permeability and susceptibility, hysteresis loop, Soft and hard materials.
2. To study the variation of thermo-e. m. f. of iron copper thermocouple with temperature.
   Description: Thermocouple, thermos-emf, Seeback effect, Peltier Effect, Thomson effect, Effect of temperature difference on metal junctions.
3. To study the Charge & Discharge of a capacitor and determine time constant.
   Description: Capacitor, types, time constant of RC and LR Circuits, application
4. To determine the high resistance by method of leakage, using a Ballistic Galvanometer.
   Description: Ballistic Galvanometer, high resistance determination.
5. To determine dielectric constant of a material using moving coil Ballistic Galvanometer.
   Description: Property of Insulators and Dielectric materials, dielectric constant and dielectric loss
6. To determine the specific resistance of the material of a wire by Carey Fosters Bridge.
   Description: Carey Fosters Bridge, Cell, Specific resistance determination of different materials and study of material property.
7. To convert a Galvanometer in to an Ammeter of range 1.5/3 amp and calibrate it.
   Description: Working principle and different types of Galvanometer and Ammeter and conversion
8. To convert a Galvanometer in to a Voltmeter of range 1.5/3 volt and calibrate it.
   Description: Working principle and different types of Galvanometer and Voltmeter and conversion
9. To study characteristics of G.M. Counting System.
   Description: Nuclear Detectors and Counters, GM Counter, dead time, quenching process, Characteristics, Quantitative analysis of nuclear radiation with distance.
10. To determine the absorption coefficient of lead using lead sheet by G.M. Counting System.
    Description: Nuclear Detectors and Counters, GM Counter, dead time, quenching process, Absorption Coefficient.
11. To measure the Numerical Aperture of an Optical Fibre.
    Description: Optical Fibre, Numerical Aperture, and Maximum Angle of Acceptance.
12. To determine coherent length and coherent time of laser using He-Ne Laser
    Description: Coherence, Coherence length, Coherence time and 'Q'factor for light, Theory of Laser Action, Threshold Conditions for Laser Action, He-Ne Laser, Semiconductor Lasers.
13. To verify the expression for the resolving power of a Telescope.
    Description: Diffraction, Resolving Power, Rayleigh Criterion for resolution
14. To determine the wave length of prominent lines of mercury by plane diffraction Grating with the help of spectrometer.
    Description: Diffraction, Grating, determine the wave length of radiations, intensity analysis, XRD, spectrometer
15. To determine the dispersive power of material of a Prism for Violet Red and Yellow colours of Mercury light with the help of a spectrometer.
    Description: Diffraction, dispersion, Grating, determine the wave length of radiations, spectrometer

16. To determine the wave length of monochromatic light with the help of Fresnel's Biprism
    Description: Interference, Determination of wavelength of unknown light
17. To determine the wave length of sodium light by Newton's Ring
    Description: Interference, Determination of wavelength of unknown light, Determination of refractive index of unknown medium.
18. To determine the wavelength of sodium light by Michelson Interferometer
    Description: Interference, Determination of wavelength of unknown light
19. To determine the specific rotation of Glucose (Sugar) solution using a Polarimeter.
    Description: Polarization, Half Wave plate, Quarter wave plate, Optical Activity, Specific Rotation.
20. To determine the height of object with the help of a Sextant.
    Description: Principle, Sextant

Text Books:

1. Dattu R Joshi, "Engineering Physics", Tata McGraw Hill Education Pvt. Ltd. New Delhi, I edn. 2010.
2. Neeraj Mehta, "Applied Physics for Engineers", PHI, I edn. 2011
3. Lab Manuals for Physics

Reference Books:

1. Arther Beiser, "Concept of Modern Physics" Tata McGrawHill, New Delhi, 5thedn. 1997.
2. Ajoy Ghatak, "Optics", Tata McGraw Hill, 4th edn.
3. Eyvind H Wichman, "Quantum Physics" Tata McGraw Hill, Volume 4.
4. B.K. Pandey, S. Chaturvedi, "Engineering Physics", Cengage Learning, 2012.
5. D.K. Bhattacharya, Poonam Tondon, "Engineering Physics", Oxford University Press, 2015.

Course Title and Course Code	**MATERIALS ENGINEERING (ME1101)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-III (Batch: 2018-2022)**

Course Objective:

The main objective of the course is to impart knowledge of materials engineering so that students can able to identify crystal structure, crystal defects, select suitable material for application based components, and control their mechanical properties.

Learning Outcomes:

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

1. Identify crystal structure, crystal defects and perform various mechanical tests as per ASTM standards to know properties of materials.
2. Evaluate materials on the basis of their static and dynamic failure criteria as per ASTM standards.
3. Perform various heat treatment processes to hold required mechanical properties in ferrous alloys.
4. Prioritize other ferrous and non-ferrous alloys for various applications.

Prerequisites		**Basics of Physics**
Sr. No	**Specifications**	**Marks**
1	Attendance	5
2	Assignment	10
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	20
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

COURSE SYLLABUS (Theory):

UNIT - I

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics.

Imperfection in Solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. **(6)**

Mechanical Property Measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery;

Hardness: Rockwell, Brinell and Vickers and their relation to strength. **(6)**

UNIT - II

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb;

Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion.

Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to nondestructive testing (NDT) **(8)**

UNIT - III

Phase Diagram: Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron. **(6)**

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening. **(6)**

UNIT - IV

Ferrous and Non Ferrous Alloys: Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based super-alloys and Titanium alloys **(8)**

COURSE SYLLABUS (Practical):

1. To evaluate microstructure of various metallic materials and prepare a comparative report.
2. To perform Tensile Test and know the tensile properties of the metallic materials
3. To perform Impact Test and know about the toughness of the metallic materials
4. To perform Hardness Test and know about the hardness value of the metallic materials
5. To perform Torsion Test on the metallic materials and calculate torsional rigidity of the materials.
6. To perform Fatigue Test on the metallic materials
7. To perform Compression Test on the metallic materials

8. To perform and compare various Heat Treatment (Anealing, Normalizing, Quenching) cycles.
9. To perform Heat Treatment cycle to understand Case Hardening.
10. Study of various ferrous and non-ferrous materials
11. Effect of strain rate on various properties of materials

Text Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

Course Title and Code: Computational Engineering Analysis – I (ES1106)	
Teaching Scheme	**L-T-P: 3-1-2**
Credits	**5**

Course Objective

The course will cover the basic components of Ordinary Differential Equations (ODE), Complex analysis and Laplace transforms and modelling & simulation of various problems in engineering discipline. Few numerical methods will be introduced to find the numerical solutions of various problems. Various domain specific Engineering problems will be discussed and appropriate simulation tools will be used for solving them.

Learning Outcomes:

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

1. Solve ordinary differential equations through various techniques.
2. Determine the structural behavior of the body by determining the stresses, strains produced by the application of load.
3. Analyze the concept of buckling and be able to solve the problems related to column and struts.
4. Model the problems of column and struts mathematically in terms of ordinary differential equations and solve them using the appropriate method.
5. Simulate the solutions of the above mentioned models of columns and struts.
6. Analyze a function of complex variables in terms of analyticity, poles and zeroes.
7. Find Laplace and inverse Laplace transforms of given function and use Laplace transform to solve ordinary differential equations.
8. Design and Evaluate the LC, RC & RL Networks using Foster'sand Cauer Forms
9. Analyze stability criteria for electrical network using pole zero plot and routh-hurwitz polynomials
10. Model and simulate electrical networks using Proteus simulator/ Virtual lab.

Prerequisites		**Nil**
Sr. No	**Specifications**	**Marks**
01	Attendance	NA
02	Assignment	NA
03	Class Participation	10
04	Quiz	20
05	Theory Exam I	20
06	Theory Exam II	NA
07	Theory Exam III	30
08	Report-1	NA
09	Report-2	NA
10	Report-3	NA
11	Project -1	NA
12	Project -2	NA
13	Project -3	NA
14	Lab Evaluation-1	10
15	Lab Evaluation-2	10

16	Course portfolio	NA
	Total (100)	100
Evaluation Scheme for Re-Test		
1	Theory Exam-III	30
	Total	30

Syllabus

ODE: Ordinary differential equations of first order and first degree, higher order ODEs with constant coefficients, Differential equation of second order with variable coefficients, Numerical solution of ODEs.

Applications of ODE in structural analysis : column and struts - Definitions, Classifications, Assumptions made in the Euler's Column Theory, Expressions for crippling load of different cases like both the ends are hinged or pinned, one end is fixed and other is free, both ends are fixed, one end is fixed other is hinged, Effective length of column, Slenderness ratio, Crippling stress in terms of Effective length and radius of gyration, limitations of Euler's Formula, Rankine's Formula, Eccentric loading, Johnson's Formula for Columns, both straight line and parabolic formula for columns.

Functions of Complex variables: Complex numbers, complex conjugates, functions of complex variables, real and imaginary parts of a complex function, analytic functions, C-R equations, Poles and zeros of a complex function, Taylor's theorem and Taylor's expansion.

Laplace transform: Basic Laplace transform and inverse Laplace Transforms, solution of ODEs using Laplace transform, solution of system of ODEs using Laplace transform.

Network Functions: Concept of complex frequency, transform independence, network functions of one and two port network, concepts of poles and zeros, properties of driving point and transfer functions, time response stability from pole zero plot, Routh-Hurwitz polynomials.

Network Synthesis: Positive real functions, Basic syntheses procedure, method of syntheses, driving point syntheses of one port network (R-L and R-C and R-L-C).

Transient Analysis: Modeling of Resistors, Inductors, capacitors, operating temperature, transient sources and transient output variables. Complete response of RL, RC, and RLC circuits to step, sinusoidal, exponential, ramp, impulses and the combinations of excitations. Initial value and final value theorem.

Textbook:

1. Advanced Engineering Mathematics, Erwin Kreysig, Wiley, India.
2. Hibbeler, R.C., "Mechanics of Materials", 6th SI edition, Prentice Hall

References:

1. Thomas' Calculus, M.D. Weir and J. Hass, Pearson.
2. Engineering Mathematics, Srimanta Pal and Subodh C. Bhunia, Oxford University Press, New Delhi, India.
3. Higher Engineering Mathematics, B.V. Ramana, Mc Graw Hill Education.
4. T.K.Nagsarkar,M.S. Sukhija,"Basic Electrical Engineering", Oxford University press, 2nd edition, 2011.
5. Roy Choudhary, "Network Theory", TMH, 3rd Edition, 2004.

6. Edminister Joseph A., “Electrical Circuits, Schaum’s Outline Series”, Tata McGraw Hill, 3rd edition, 2012.
7. Hayt W.H., Kemmerly J. E., Durbin S. M., “Engineering Circuit Analysis”, Tata Mcgraw Hill, 6th edition, 2006.
8. Beer, F.P., Johnston, E.R., DeWolf, J.T., “Mechanics of Materials”, 4th edition, McGraw Hill. Craig, R.R., “Mechanics of Materials”, 2nd edition, John Wiley and Sons.

Course Title and Course Code	**Engineering Measurements and Machine (ES1107)**
Hours per Week	**L T P: 3 0 4**
Credits	**5**
Students who can take	**B. Tech Semester-III**

Course Objectives:

The aim of this course is to impart the knowledge of mechanical and electrical machine used in industries. Students will learn the fundamental of engineering principles governing the engineering process and its use in real-world. Students will get the knowledge of sensors, actuators and its selection process for any industrial application.

Learning Outcomes:

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

1. Evaluate suitable electrical and non-electrical instruments for measuring physical quantities.
2. Analyze the construction, characteristics and applications of various types of rotating machines.
3. Analyze the working of any mechanical and electrical machine using mathematical model.
4. Integrate the sensors for monitoring and automation of electrical and mechanical systems.
5. Design electro-mechanical machines as per Indian standards.

Prerequisites	**Basics of Physics**

Evaluation Scheme

Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	20
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	10
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio (MOOC Course)	10
Total (100)		**100**

Evaluation scheme for Retest		Marks
1	Theory Exam	20
2	Lab Evaluation (Exam)	10
Total		**30**

Syllabus (Theory):

Unit-I: Measurement, Instrumentation and Calibration
Introduction, types of applications of measurement instrumentation, performance characteristics, error in measurements, calibration and standards, static and dynamic characteristics of instrument, Measuring Instruments, Digital meters, Function Generators, AC Bridges, Electronic Instruments for Measuring Basic Parameters.

Unit-II: Transducers
Classification of transducers, Selection of transducers, measurement of physical quantities, Elements of data acquisition system, Smart sensors.

Unit-III: Transformers
Construction, principle of operation, equivalent circuit, losses, testing, efficiency and voltage regulation, auto transformer, three phase connections, parallel operation of transformers, tap changing.

Unit-IV: Rotating Machines
DC Machines
Construction, EMF and torque equation, circuit model, armature reaction, methods of excitation, characteristics of generators, characteristics of motors, starting and speed control, testing and efficiency.
Induction Motors: Construction, working principle, classification and applications, equivalent circuit, Torque - slip characteristics, starting and Speed control of induction motors.

Unit-V: Mechanical Machines
Turbines: Introduction to steam turbines, Impulse and Reaction turbines, turbine power and related calculations.
Pumps: Introduction of pumps, centrifugal pumps, working of centrifugal pumps, Cavitation and its effect on pump, working of reciprocating pumps, Application of pumps in industries.
Power Transmission Systems: Mechanical drives and their performance analysis.

List of Experiments:
Measurement
1. To Determine Output characteristics of LVDT and Measure of Displacement Using LVDT.
2. Measurement of Inductance using Maxwell's bridge.
3. Measurement of earth resistance by earth tester and measurement of Insulation resistance by Megger.

Electrical Machines

1. To perform Ratio, Polarity and Load test on a single-phase transformer.
2. To perform open circuit and Short circuit test on a single-phase transformer and hence determine its equivalent circuit parameters.
3. To find the relation between open circuit voltage and field current of:
   (i) Separately excited DC generator, (ii) Self excited DC shunt generator
4. Speed control of DC shunt motor: (i) By varying field current with armature voltage constant.
   (ii) By varying armature voltage with field current kept constant.
5. To perform No load and blocked rotor test on a three-phase Induction Motor, and hence determine its equivalent circuit parameters.

Mechanical Machines

1. To study the performance of turbines used in steam power plant
2. To study the performance of belt drive system used for power transmission.

Text Books:

1. H S Kalsi, Electronic Instrumentation, McGraw Hill Education (India) Private Limited.
2. Nagrath I. J and Kothari D. P. 'Electric Machines', Tata McGraw Hill Publishing Company Ltd.
3. B. L. Theraja, and A. K. Theraja, Text of Electrical Technology, Vol -2; S. Chand Publication.
4. J B Gupta, Theory and Performance of Electrical Machines, S.K. Kataria and Sons.
5. Ashfaq Hussain, Electrical machines, Dhanpat Rai and Co.
6. P S Bimbhra, Generalised theory of rotating machines, Khanna Publishers.
7. R K Bansal, A Textbook of Fluid mechanics and Hydraulic machines, Laxmi Publication (P) ltd.
8. S S Ratan, Theory of Machines, Tata McGraw-Hill.

Reference Books:

1. Fitzgerald and C. Kingsley Jr., Electric Machinery, McGraw-Hill Book Co.
2. Chapman, Electric Machinery Fundamentals, The McGraw-Hill Companies, Inc.

Online sources:

Electrical Measurement and Electronic Instruments
https://nptel.ac.in/courses/108/105/108105153/

Sensors and Sensor Circuit Design
https://www.coursera.org/programs/j-k-lakshmipat-university-on-coursera-kzogk/browse?index=prod_enterprise_products&productId=487N_QqXEeeqsQo32tjRBA&productType=course&query=Sensor&showMiniModal=true

Electrical Machines
https://nptel.ac.in/courses/108/102/108102146/

Motors and Motor Control Circuits
https://www.coursera.org/programs/j-k-lakshmipat-university-on-coursera-kzogk/browse?index=prod_enterprise_products&page=3&productId=-

i5RF2jdEeecwwoEvbWpsg&productType=course&query=Electrical+Machines&showMiniModal=true

Turbines and Pumps
https://nptel.ac.in/courses/112/103/112103249/

Power Transmission Systems
https://www.youtube.com/watch?v=3UaFeNm_ZF8

Course Title and Code: Engineering Thermodynamics ME1102	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	**B. Tech Semester-III (Core)**

Course Objective:

The objective of the course is to develop understanding of mass, energy, heat, work, efficiency, ideal and real thermodynamic cycles and processes. This also covers first and second laws of thermodynamics, perfect gas law, properties of real gases, and the general energy equation for closed and open systems.

On successful completion of the this course, the student should be able to:

1. identify the basic thermodynamic processes in our day to day life and industrial processes
2. judge the state of the pure substances such as compressed liquid, saturated liquid-vapor mixture and superheated vapour using property diagrams and tables.
3. apply the first law of thermodynamics to analyse the working of the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow
4. construct energy and mass balance for unsteady-flow processes.
5. assess thermodynamic applications using second law of thermodynamics to power and refrigeration cycle.

Sr. No	Specifications	Marks
1	Attendance	
2	Assignment	10
3	Class Participation	10
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	15
7	Theory Exam-III	25
8	Report-I	
9	Report-II	
10	Report-III	
11	Project-I	
12	Project-II	
13	Project-III	
14	Lab Evaluation-I	20
15	Lab Evaluation-II	
16	Course Portfolio	
	Total (100)	**100**

Syllabus:

Areas of Application of Thermodynamics, Different Approaches in the study of Thermodynamics, SI Units, Definitions and Concepts: System, Energy, Work; Thermodynamic equilibrium, Properties, Heat & Work, System, Surroundings, Types of Systems, Intensive and Extensive Properties, Energy, Macroscopic modes of Energy, Microscopic modes of Energy, Thermodynamic Equilibrium, Process, Work, Thermodynamic Definition of Work , Heat,

Introduction to state postulate, Zeroth Law of Thermodynamics, Temperature Scale , Perfect Gas Scale .

First-Law of Thermodynamics and Analysis of Closed Systems: First Law of Thermodynamics, Heat is a Path Function, Energy is a Property of the System, A Perpetual Motion Machine of First Kind, Analysis of Closed Systems, Characterisation of Reversible Adiabatic Process, Polytropic Process, Ideal Gas Model.

First-Law of Thermodynamics for the Flow Processes: Conservation of Mass applied to a control volume, Conservation of Energy applied to a Control Volume, Steady State Flow Processes, Application of Steady State Flow Processes, Throttling Process, Application of Throttling Process .

Thermodynamic Properties of Pure Substances: Thermodynamic Properties of Fluids, Pure substance, Equations of State, Ideal Gas, Thermodynamic diagrams and tables, phase-Change Process of Pure Substances, Specific internal energy and enthalpy, Steam Tables.

Second Law of Thermodynamics, Entropy and Availbility: Limitations of First Law of Thermodynamics, Heat Engine, Heat Pump, Refrigerator, Kelvin Planck Statement, Clausius Statement of the Second Law, Reversibility, Irreversibility and Carnot cycle Carnot's Principles (Theorems), Thermodynamic Temperature Scale, Reversible Cycles and Clausius Inequality

Entropy: Concept of Entropy, Principle of Entropy Increase, calculation of entropy change. Temperature Entropy Diagram & Second Law Analysis of a Control Volume:Temperature Entropy Diagram, Second law analysis of a control volume, Steady-state steady-flow processes, TdS Equations, Entropy change of an incompressible substance, criterion of equilibrium, Thermodynamic definition of temperature, pressure and chemical potential, Thermodynamic potentials.

Availability & Irreversibility: Availabilty Function and Irreversibility: Introduction, Availability Function for a non-flow Process, Availability Function of Flow Processes, Irreversibility.

Power and Refrigeration Cycles: Introduction, Practical Rankine Cycle, Reheat Cycle (continuation of Rankine cycle), Regenerative Cycle, Binary Vapor Cycle. Introduction to Gas Power Cycles: Introduction, Air standard Otto Cycle, Air standard Diesel Cycle. Air Standard Dual Cycle, Comparison of Otto, Diesel & Dual Cycles, Air Standard Brayton Cycle. Reversed Carnot Cycle as a Refrigeration Cycle, Vapour Compression Cycle, Refrigerants, Absorption Refrigeration System, Heat Engine, Gas Refrigeration Cycle.

Thermodynamic Relations: Introduction, Important Mathematical Relations, Jacobian Method, Cyclic Rule, Maxwell Relations, Thermodynamic Relations involving Entropy Clapeyron Equations: Clapeyron Equations, Kirchhoff's equations, Change of Latent Heat with Temperature.

Text Books:

1. Yunus A Cengel, "Thermodynamics: An Engineering Approach" McGraw Hill Education; Eighth edition
2. PK Nag, "Engineering Thermodynamics" McGraw Hill Education
3. M. Achuthan, "Engineering Thermodynamics" Prentice-Hall of India

Reference Books:

1. P W Bridgman, "The Nature of Thermodynamics" Harvard University Press

Perspectives on Contemporary Issues
Course Code: CC1103
Credit: 2
L-T-P: 2-0-1

Course Description:
In an era of globalization, there is an increasing need for the youth to be able to empathize with others, value diverse perspectives and cultures and understand how events around the world are intertwined. Global issues revolve around social, economic and environmental factors which ultimately add to the interconnectedness of countries. In this course, students will employ key critical thinking concepts to analyze contemporary issues from multiple perspectives. They will explore the impact at micro and macro levels.

Course Outcomes:
The students will be able to:
- Identify different perspectives objectively.
- Explain interconnectedness of the issues and their impact at micro and macro levels.
- Recognize their own beliefs, biases, claims and assumptions.
- Evaluate sources, argue and defend effectively.

Teaching Pedagogy:
This course will be an amalgamation of brief lectures and activity based learning i.e. films, group discussions, debates, and case studies. The objective behind utilizing activity based learning is for the learners to have a more hands on experience. This will encourage and ensure active participation and longer retention. The idea is for learners to feel engaged and also express their views in a conducive environment. The takeaway from this course will not only be awareness about certain issues but equipping learners with skills of decision making and reasoning in alignment with certain global contexts.

Course Content:
- **Introduction to contemporary perspective**
- **Research, analysis & evaluation of a topic from local, national and global perspectives on:**
- **Climate Change and Sustainability**
  Understanding the magnitude of the issue, its impact and future challenges.
  How we can meet our current needs without diminishing the quality of the environment or reducing the capacity of future generations to meet their own needs.
- **Globalization**
  With increasing development throughout the world, the focus of this theme will be on the impact of globalization in India**.**
- **Nationalist Movement**
  There is a sense that excesses of globalization have created an identity crisis across the world, facilitating the rise of nationalist movements. Rising nationalism is seen everywhere, from the election of Donald Trump to Brexit, the success of far-right parties in Italian, German and Austrian elections in 2017 and 2018, nationalism appears to be on rise globally. We will look at its reasons and implication**.**
- **Technology**

Impact of unprecedented technological growth, challenges and opportunities.

- **Social justice and human rights**
  An understanding of the impact of inequality and discrimination, the importance of standing up for our own rights and our responsibility to respect the rights of others

Evaluation Scheme:

Sr. No	Specifications	Weightage (%)
01	Assignment	20
02	Class Participation	20
03	Theory Exam II	15
04	Theory Exam III	25
05	Report	20
	Total (100)	**100**

References for Reading:

1. Harari, Y. N. (2019). 21 Lessons for the 21st century. Toronto: CELA.
2. Guha, R. (2019). India After Gandhi: the history of the world's largest democracy. NEW YORK: ECCO.
3. Rosling, H., Rosling, O., & Rönnlund Anna Rosling. (2019). Factfulness: ten reasons were wrong about the world - and why things are better than you think. London: Sceptre.
4. Kolbert, E. (2015). The Sixth Extinction: An unnatural History. Bloomsbury

Course Name: Programming Week
Course Code: CS1104
Credits: 2

Course Description: This course teaches object-oriented programming to those who have learnt basic programming concepts and are ready to learn in-depth programming. It focuses on object-oriented programming using JAVA. The main concepts are: Classes, Objects, Data Abstraction, Data Encapsulation, Overloading, Overriding, Polymorphism, Inheritance, Interfaces, Exception Handling, and Database Connectivity. This course also covers basic concepts for software design and reuse.

Learning Outcome:

1. On successful completion of this course, the students should be able to:
2. Name and apply some common object-oriented design patterns and give examples of their use.
3. Write programs in Core JAVA.
4. Design, develop and debug software applications taking into account coding and documentation standards.
5. Apply concepts like interfaces and abstract classes in Java program design and implementation.
6. Design and create web based and other applications using practices of object oriented concepts.
7. Use java collection API.
8. Evaluate different integrated development environment e.g. NetBeans, Eclipse with respect to creation.
9. Use energy saving programming practices.

Enterprise Programming Using Java

Unit 1: Basics of Java & Decision Statements - Introduction to Java: Features of Java, Byte Code and JVM, JDK, JRE; Data types and Operators: Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Datatypes, ADT, Operator types and precedence, Statements and Flow Control: Conditional statements, looping, return, etc., Abstract data types and their specification. How to implement an ADT. Concrete state space, concrete invariant, abstraction function.

Unit 2: Control Structures, Methods & Constructors - Object Oriented Programming in Java: Object Life time & Garbage Collection. Methods & Constructors - Constructor & initialization code block, Parameterized Constructor, Loops, Methods.

Unit 3: Array & String - Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Operation on String, Mutable & Immutable String, Collection Bases Loop for String, tokenizing a String, Creating Strings using StringBuffer. OOP's Concept I - Class Fundamentals, Object & Object reference, Access Control, Modifiers, Methods in Java: Method Declarations, Method Signatures, Invoking Methods,

Unit 4: OOP's Concept II - Static vs. Instance Data Fields, Static vs. Instance Methods, Method Overloading, Encapsulation. Inheritance, Composition, and Aggregation, Invoking Base Class Constructors, Overriding vs. Overloading, Polymorphism Overloading,

Unit 5: Interfaces - Inner Class & Anonymous Classes, Abstract Class, Interfaces. Exception Handling - Introduction to Exception handling.

NOTE: Integrated Development Environments (IDEs) to be used in this Course are Eclipse or NetBeans – Both are compatible for Enterprise Programming using Java.

Prerequisites		
Teaching Scheme (Hours per Week)		Programming Week
Credits		2
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	
2	Assignment	10
3	Class Participation	10
4	Quiz	10
5	Theory Exam-I	
6	Theory Exam-II	40
7	Theory Exam-III	
8	Report-I	
9	Report-II	
10	Report-III	
11	Project-I	
12	Project-II	
13	Project-III	
14	Lab Evaluation-I*	30
15	Lab Evaluation-II	
16	Course Portfolio	
	Total (100)	100

References

1. Liang, Y. Daniel. Introduction to Java programming: comprehensive version. Pearson Education, 2018.
2. Horstmann, Cay S., and Gary Cornell. Core Java 2: Volume I, Fundamentals. Pearson Education, 2016.
3. Schildt Herbert. The Complete Reference, Java 2, Fourth Edition. TMH, 2017.

Course Title and Course Code	**ENGINEERING DRAWING (ME1103)**
Hours per Week	**L T P: 0 0 2**
Credits	**1**
Students who can take	**B. Tech Semester-III**

Course Objective:

To introduce the students to the "universal language of Engineers" for effective communication through drafting exercises of geometrical solids.

Learning Outcomes:

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

1. Identify and describe different components shown in engineering drawings
2. Develop geometrical solids in 3D space using orthographic projections
3. Geometrically construct curves and surfaces using projection of points and lines

Prerequisites		**Basics of Physics**
Sr. No	**Specifications**	**Marks**
1	Attendance	5
2	Assignment	NIL
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	NIL
6	Theory Exam-II	20
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	20
15	Lab Evaluation-II	20
16	Course Portfolio	NIL
Total (100)		**100**

COURSE SYLLABUS (Theory):

UNIT – I
Introduction to Engineering Drawing, Orthographic Projections:
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales Plane and Diagonal Scales, Angle of projection**.**

UNIT - II
Projection of line.

Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes. Determination of true lengths and true inclinations by rotating line method and traces.

UNIT - III

Projections of plane

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

Projections of regular solid.

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

Sections of Regular Solids

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

UNIT - IV

Development of surface

Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

Text Books:

1. Engineering Drawing: N.D.Bhatt & M.Panchal 37th Edition 1996, charotar publishing House Gujarat
2. Engineering Drawing & Design: Cencil Jensen, Jay D. Helsel, Dennis R. Short, Seventh Edition, Tata Mcgraw Hill 2012
3. "Engineering Graphics" by K.L. Narayana and P.Kannaiah, scitech publications (india) pvt.ltd. october 2008
4. Engineering Drawing: K.R. Gopal Krishna, 24 th Edition 1999 Subhash publications, Bangalore

Course Title and Code: Transport Phenomena ME1104	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	**B. Tech Semester-IV (Core)**

Course Objective:

The objective of this course is to introduce the concepts of transport phenomena, which deals with the movement of different physical quantities such as momentum, energy and mass in any chemical or mechanical process and combines the basic principles (conservation laws) and laws of various types of transport. The topics included in this course are aimed to prepare a student to build a good fundamental background useful in the application-intensive courses covering hydraulics and energy transfer equipment design in later semesters.

On successful completion of this course, the student should be able to:

1. identify the basic transport processes in our day to day life and industrial processes
2. apply the continuity, momentum and energy principles and dimensional analysis
3. formulate and analyse a heat transfer problem involving any of the three modes of heat transfer
4. apply the appropriate correlations to calculate heat transfer coefficient and heat flux for a range of heat transfer situations (Steady and unsteady)
5. design and model a real life low energy heat transfer equipment as per ASME standard
6. Analyse the combined effect of heat, mass and momentum transport in a typical chemical engineering equipment (heat exchanger, catalyst bed, chemical reactor, etc.)

Sr. No	**Specifications**	**Marks**
1	Attendance	--
2	Assignment	5+5
3	Class Participation	--
4	Quiz	5+5
5	Theory Exam-I	15
6	Theory Exam-II	15
7	Theory Exam-III	25
8	Report-I	--
9	Report-II	--
10	Report-III	--
11	Project-I	--
12	Project-II	--
13	Project-III	--
14	Lab Evaluation-I	10
15	Lab Evaluation-II	15
16	Course Portfolio	--
	Total (100)	**100**
Evaluation for retest		
1	Theory Exam-III	25
2	Lab Evaluation-II	15
	Total	**40**

Syllabus:

Momentum Transport:

Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity, Newton law of viscosity, vapour pressure, boiling point, cavitation, surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Fluid Statics - Fluid Pressure, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U Tube Differential Manometer, Micromanometers, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Fluid Kinematics-Classification of fluid flow: steady and unsteady flow, uniform and non-uniform flow, laminar and turbulent flow, rotational and irrotational flow, compressible and incompressible flow, ideal and real fluid flow, one, two and three dimensional flows, Stream line, path line, streak line and stream tube, stream function, velocity potential function. One-, two- and three - dimensional continuity equations in Cartesian coordinates

Fluid Dynamics- Surface and body forces, Equations of motion - Euler's equation, Bernoulli's equation – derivation, Energy Principle, Practical applications of Bernoulli's equation, venturimeter, orifice meter and pitot tube, Momentum principle, Forces exerted by fluid flow on pipe bend, Vortex Flow – Free and Forced, Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number, Buckingham's π-Theorem.

Energy Transport

Energy equation, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins.

Convection: basic equations, boundary layers- Forced convection, external and internal flows, Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Radiation**:** Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method

Mass Transport:

Introduction mass transfer, Diffusion mass transfer, Fick's law of diffusion, Steady state molecular diffusion, Convective mass transfer and mass transfer coefficient, Interphase mass transfer, Momentum, heat and mass transfer analogy.

Distillation: Vapour liquid equilibrium, Flash vaporization, steam distillation, batch distillation, and continuous multistage fraction of binary mixtures.

Drying of wet solids: Physical mechanism of drying, drying equilibria, drying rate curve, calculation of the drying time from the drying rate data, classification of drying equipment. Adsorption: Commercial adsorbents and their applications, characteristics and properties of adsorbent, Adsorption equilibria, selection of adsorbents, adsorbent equipments.

Text Books:

1. Cengel Y. and Cimbala J., "Fluid Mechanics" Tata McGraw-Hill, New Delhi, 2014.
2. White F. M., "Fluid Mechanics" Tata McGraw-Hill, New Delhi, 2011.
3. Bird, Stewart and Lightfoot, "Transport Phenomena"', John Wiley & Sons, 2002.
4. Incropera F P "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 2011.
5. Cengel Y. "Heat and Mass Transfer" Tata McGraw-Hill, New Delh, 2014i.

Reference Books:

2. Fox and McDonald, "Introduction to fluid dynamics", John Wiley & Sons, 2018.
3. Holman J.P. "Heat Transfer" Tata McGraw-Hill, New Delhi, 2008.
4. Robert T., "Mass Transfer Operations" Tata McGraw-Hill, New Delhi, 1995.
5. Binay K. Dutta, Principles of Mass Transfer and Separation Processes, PHI Learning Pvt.Ltd. Delhi, 2007.

Lab Experiments

Measurement of viscosity, Study of Pressure Measuring Devices, Stability of Floating Body, Hydrostatics Force on Flat Surfaces/Curved Surfaces, Verification of Bernoulli's Theorem, Venturimeter, Orifice meter, Impacts of jets, Flow Visualisation -Ideal Flow Length of establishment of flow, Velocity distribution in pipes, Laminar Flow, Convective heat transfer (Numerical). Solid/ liquid in air diffusion.

Course Title and Course Code	**Strength of Material & Analysis (ME1105)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-IV ME**

Course Objective:

The key objective of this course is to acquaint the students with fundamentals of stress and strain for 1-D, and 2-D systems, factors cause failure and theories to avoid failure.

Learning Outcomes:

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

1. identify stress and strain present in a mechanical system.
2. analyze and evaluate 1-D and 2-D stress tensor in a specimen.
3. analyze shear force and bending moment diagrams for a beam under different loading conditions.
4. design shafts against torsion load for different application.
5. design columns against buckling load for various end conditions.

Sr. No	Specifications	Marks	S#1	S#2
1	Attendance	NIL	NIL	NIL
2	Assignment	10	10	10
3	Class Participation	NIL	NIL	NIL
4	Quiz	10	10	10
5	Theory Exam-I	10	10	10
6	Theory Exam-II	NIL	NIL	NIL
7	Theory Exam-III	30	30	30
8	Report-I	NIL	NIL	NIL
9	Report-II	NIL	NIL	NIL
10	Report-III	NIL	NIL	NIL
11	Project-I	20	20	20
12	Project-II	NIL	NIL	NIL
13	Project-III	NIL	NIL	NIL
14	Lab Evaluation-I (Continuous)	10	10	10
15	Lab Evaluation-II (Exam)	10	10	10
16	Course Portfolio	NIL	NIL	NIL
Total (100)		**100**	**100**	**100**

Evaluation scheme for Retest		Marks		
1	Theory Exam-Retest	30	30	30
Total (30)		**30**	**30**	**30**

COURSE SYLLABUS (Theory):

UNIT 1 Stresses and Strains

Simple Stresses and Strain: Introduction, Definition and concept and of stress and strain. Hooke's law, Stress-Strain diagrams for ferrous and non-ferrous materials, factor of safety, Elongation of tapering bars of circular and rectangular cross sections, Elongation due to self-weight. Saint-Venant's principle, Compound bars, Temperature stresses, Compound section subjected to temperature stresses, state of simple shear, Elastic constants and their relationship.

Unit II Multiaxial Stress-Strain System

Introduction to Biaxial stresses, state of stress at a point, General two-dimensional stress system, Principal stresses and principal planes, Mohr's circle of stresses and Introduction to Theories of Failure.

Thin and Thick Cylinders (Cartesian Coordinates): Introduction, Thin cylinders subjected to internal pressure; Hoop stresses, Longitudinal stress and change in volume. Thick cylinders subjected to both internal and external pressure; Lame's equation, radial and hoop stress distribution.

UNIT III Theory of Beams

Introduction to types of beams, supports and loadings. Definition of bending moment and shear force, Sign conventions, relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beams subjected to points load, uniformly distributed loads, uniformly varying loads, couple and their combinations, Deflection of beams by Double integration method–Macaulay's method–Area moment theorems for computation of slopes and deflections in beams –Conjugate beam method.

UNIT IV Bending and Torsion

Theory of simple bending –bending stress and shear stress in beams, assumptions, bending equation, modulus of rupture, section modulus, flexural rigidity, Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections.

Introduction, pure torsion, Assumptions, Torsion equation for circular shafts, torsional rigidity and polar modulus Power transmitted by a shaft, combined bending and torsion.

UNIT V Column and Struts and Introduction to 3-D stresses

Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns. Fundamentals of theory of elasticity.

COURSE SYLLABUS (Practical):

1. To evaluate stress strain curve for tension test on a standard Mild Steel specimen on Universal Testing Machine UTE-20.

2. To evaluate stress strain curve for compression test on a standard Mild Steel specimen on Universal Testing Machine UTE-20.
3. To conduct impact test on a mild steel specimen, IT-30.
4. To conduct torsion test on a mild steel specimen, TTE-10.
5. To conduct Rockwell Hardness Test.
6. To conduct Brinell's Hardness Test.
7. To conduct Vickers Hardness Test, VM-50.
8. To conduct fatigue test on Fatigue Testing machine, FTG 8(D).
9. To conduct bending stress in a beam, STR 5.
10. To write a MATLAB program to generate principle stress, shear stress of a given element and plot the same.
11. To write a MATLAB program to generate 2-D principle stress, shear stress of a given element and plot the same.
12. To write a MATLAB program to generate Mohr's Circle of a given element and plot the same.
13. To develop a CAD Simulation model of Mild steel specimen for conducting simulation.
14. To develop a CAD Simulation model of Aluminum specimen for conducting simulation.

Text Books:

1. S. S. Rattan "Strength of Materials" McGraw Hill Education (India) Pvt. Ltd., 2nd Edition (Sixth reprint 2013)
2. Popov, Egor Paul. Engineering mechanics of solids. Prentice Hall, 1990.
3. R. K. Bansal, "A Textbook of Strength of Materials", 4th Edition, Laxmi Publications, 2010.

Reference Books:

1. Timoshenko, S. and Goodier, J. N., "Theory of Elasticity", Tata McGraw Hill, New Delhi, 3rd edition, 1970
2. Srinath, L. S., "Advanced Mechanics of Solids", Tata McGraw Hill, New Delhi, 3rd edition, 2010
3. Ferdinand P. Beer, E. Russell Johnston and Jr. John T. DeWolf "Mechanics of Materials", Tata McGraw-Hill, Third Edition, SI Units.
4. D.H. Young, S.P. Timoshenko "Elements of Strength of Materials" East West Press Pvt. Ltd., 5th Edition (Reprint 2014)
5. Vazirani, V. N., Ratwani M. M. and S K Duggal "Analysis of Structures Vol. I", 17th Edition, Khanna Publishers, New Delhi.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ES1109	Computational Engineering Analysis – II	3	1	2	0	5

Course Objectives: The course will develop ability to use Partial Differential Equations (PDE), Fourier transforms and Z-transform for a variety of Engineering applications from fluid dynamics, heat conduction and circuit design**.** It also aims to develop skills for using common simulation software i.e. ANSYS Fluent and MATLAB. Few numerical methods will also be introduced to find the numerical solutions of various problems.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Classify various types of partial differential equations and solve them through various analytical and numerical methods.
2. Formulate and analyze differential equations especially Navier stokes and energy equations and use numerical methods for solving the same.
3. Use CFD software to model relevant engineering flow problems.
4. Find Fourier and inverse Fourier transforms of given function and use Fourier transform to solve partial differential equations.
5. Find Z-transform and inverse Z-transforms of given functions and use them to analyse control systems.
6. Design and analyse various types of filters and attenuators to minimize power losses and improve signal quality.
7. Solve problems involving vertex and edge connectivity, planarity and crossing numbers.

Assessment Scheme:

Prerequisites		**Elementary Calculus**
Teaching Scheme (Hours per Week)		**L T P 3 1 2**
Credits		**5**
S No	**Evaluation Component**	**Marks**
1	Attendance	NA
2	Assignment	10
3	Class Participation	NA
4	Quiz	5
5	Theory Exam-I	15
6	Theory Exam-II	15
7	Theory Exam-III	30
8	Report-I	NA
9	Report-II	NA
10	Report-III	NA
11	Project-I	NA
12	Project-II	NA
13	Project-III	NA
14	Lab Evaluation-I	10

15	Lab Evaluation-II (Continuous)	15
16	Course Portfolio	NA
	Total (100)	100
Evaluation Scheme for Re-Test		
1	Theory Exam-III	30
	Total	30

Course Syllabi (Theory):

PDE: Partial Differential Equations of First Order, Variable separable technique for solving PDE. Heat equation, wave equation, Laplace equation

Boundary value problems: Solution of boundary value problems using separation of variables technique.

Numerical solution of PDE.

Application of PDE: Momentum and Energy Transport:

The governing equations of fluid dynamics- models of the flow, continuity equation, momentum equation, Energy equation, boundary conditions. Poisouli's flow, Couette flow, steady and unsteady conduction.

Fourier Transforms: Fourier transform and inverse Fourier transform, properties of Fourier transform, Applications in solving Partial differential equations.

Filter Circuits: Types of passive filters, design low-pass, High-pass, Band-pass, Band-reject filters as constant k type, design low-pass, High-pass, Band-pass, Band-reject filters as m-derived type, Advantages of active filters over passive filters.

Graph Theory: Introduction, Linear graph of a network, Tie-set and cut-set schedule, incidence matrix, cut-set, and tie-set. Graph theory application to a practical radial system.

Z-transform: Introduction, standard z- transform, properties of z – transform, initial and final value theorems, inverse z-transform, applications in control systems.

Textbook:

1. Advanced Engineering Mathematics, Erwin Kreysig, Wiley, India.
2. White F. M., "Fluid Mechanics" Tata McGraw-Hill, New Delhi.
3. Incropera F P "Principles of Heat and Mass Transfer", John Wiley & Sons.
4. Hayt W.H., Kemmerly J. E., Durbin S. M., "Engineering Circuit Analysis", Tata Mcgraw Hill, 6th edition, 2006.

Reference Books –

1. Thomas' Calculus, M.D. Weir and J. Hass, Pearson.
2. Engineering Mathematics, Srimanta Pal and Subodh C. Bhunia, Oxford University Press, New Delhi, India.
3. Higher Engineering Mathematics, B.V. Ramana, Mc Graw Hill Education.
4. Fox and McDonald, "Introduction to fluid dynamics", John Wiley & Sons.
5. Cengel Y. "Heat and Mass Transfer" Tata McGraw-Hill, New Delhi.
6. J. D. Anderson Jr. "Computational Fluid Dynamics" McGraw-Hill International Edition.
7. Roy Choudhary, "Network Theory", TMH, 3rd Edition, 2004.
8. Edminister Joseph A., "Electrical Circuits, Schaum's Outline Series", Tata McGraw Hill, 3rd edition, 2012.

Course Title	**Production Technology – I**
Course Code	**ME1106**
Hours per Week (L T P)	**3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-IV (Batch: 2018-2022)/Core**

Course Objective:

To impart knowledge about principles/methods of casting with knowledge of pattern, molding, casting methods in order to get sound casting. To impart knowledge about welding processes in order to get sound permanent joints of metal and metal alloys. To impart knowledge of working principles of various non-conventional and advanced machining processes.

Learning Outcome:

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

1. Design molding system to obtain defect free cast.
2. Analyze various welding processes for different applications.
3. Identify non-conventional manufacturing process to manufacture intricate shaped product accurately.
4. Identify latest manufacturing systems and processes for manufacturing of components.

Prerequisites: Basics of Materials Engineering

Sr. No	Specifications	Marks
1	Attendance	5
2	Assignment	10
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	20
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

Evaluation scheme for Re-test

Sr. No	Specifications	Marks
1	Theory Exam-III (Re-test)	30
Total (30)		**30**

Course Syllabus (Theory)

Conventional Manufacturing processes:

UNIT-I
Casting and molding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, gating system design, riser design, casting defects and residual stresses.
Melting Practices: Cupola, Induction Furnaces

UNIT-II
Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes, welding defects; Adhesive bonding.

Unconventional Machining Processes:

UNIT-III
Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters.
Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining

UNIT-IV
Introduction to Flexible Manufacturing System, Additive manufacturing: Rapid prototyping and rapid tooling.

Text Book(s)

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black & Kohser, Materials and Processes in Manufacturing
4. Amitabh Ghosh & Mallik, Manufacturing Science, Affiliated East-West Press Pvt Ltd, New Delhi.

Reference Book(s)

1. Rao P. N. "Manufacturing Technology: Foundry, Forming and Welding" TMH, 2013.
2. James S. Campbell "Principles of Manufacturing Materials and Processes", TMH.
3. G.E. Linnert, "Welding Metallurgy" AWS.
4. Cook "Manufacturing Analysis"Adisson-Wesley
5. R. K. Jain "Manufacturing Engineering Technology" Pearson Education
6. P. C. Pandey and C. K. Singh "Production Engineering Sciences" Standard Publishers Ltd.

Course Syllabus (Practical):

1. To determine moisture content in molding sand,
2. To determine the clay content of molding sand,
3. To perform the Hardness Test to know hardness of molding/core sand.
4. To prepare wood/metal pattern for casting process.
5. To cast a liquid Aluminum metal by using sand molding.
6. Investigate the casting defects and suggest the remedial measures.
7. To make a component involving horizontal and vertical welding using gas welding.
8. To make a component using TIG welding setup.
9. To make a component using MIG welding setup.
10. To prepare a permanent joint on mild steel plate using gas welding.
11. To prepare a permanent joint on thin metallic sheet using spot welding.
12. To find out average grain fineness number using sieve shaker.

Communication and Identity
Course Code: CC1104
Credit: 2
L-T-P: 2-0-1

Course Description:
This course enables students to explore their personal and professional identities, to create their distinctive presence. It intends to help them gain an understanding of the basic purpose, benefits, and responsibilities of self-presence, and to begin the process of defining their values, strengths, and goals, which also helps them enhancing their professional readiness.

Learning Outcomes:
- Analyse their personal identities, both private and social
- Identify their different values, strengths and areas of professional interest
- Articulate their personal statement and use it to craft an influential pitch
- Express themselves through various communication formats on different platforms

Course Contents
1. **Self- identity**
2. **Personal Statement**
3. **Internal confidence or "principle centered living"**
4. **External and internal locus of Identity**
5. **Steps to build Personal Identity**
6. **Online presence**
7. **Elevator Pitch, Cover Letter**

Evaluation Scheme:

Sr. No	Specifications	Weightage	
		Original	**Revised (post covid 19)**
1	Attendance	Nil	Nil
2	Assignment	30	30
3	Class Participation	30	30
4	Quiz	Nil	Nil
5	Theory Exam II	Nil	Nil
6	Theory Exam III	20	25 (Continuous Evaluation)
7	Theory Exam	20	15 (Evaluation Based on Mooc Course Completed)
	Total (100)	**100**	**100**

References for Reading:

1. O'Brien, T. (2019). When your job is your identity, professional failure hurts more. Harvard Business Review.
2. Anca, C., & Aragón, S. (2018). The 3 types of diversity that shape our identities. Harvard Business Review.

3. Craig, N., & Snook, S. (2014). From purpose to impact. Harvard business review, 92(5), 104-111.
4. Detert, J. R. (2018). Cultivating everyday courage. Harvard Business Review, 96(6), 128-135.
5. Dutta, S. (2010). What's your personal social media strategy? Harvard business review, 88(11), 127-30.

Course Title: Introduction to Design Course Code: **IL1102**	
Hours per Week	30
Credits	2
Students who can take	2nd Year B. Tech

Course Objective: Taking an idea forward from an intangible thought to a material-based product or visually communicable form requires a definitive plan of action. Using the methods of design thinking and design process the students will be able to bring their ideas to life.

Learning Outcome:
On successful completion of this course, the students should be able to:

1. Sketch their ideas on paper to visualize and assess viability.
2. Create a plan for process and management to materialize the desired idea.
3. Test the material for possibilities and capabilities.
4. Develop skills of joinery, material manipulation and various hand tools.
5. Develop technical and narrative skills useful for both film and animation.
6. Develop Troubleshooting and problem solving skills.

Evaluation Scheme

Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	20
3	Class Participation	10
4	Quiz	Nil
5	Theory Exam I	Nil
6	Theory Exam II	Nil
7	Theory Exam III	Nil
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	35
12	Project -2	35
13	Project -3	Nil
14	Lab Evaluation1	Nil
15	Lab Evaluation2	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Course Contents:

Introduction to Design Process.
Material properties – wire and wood.
Material joinery – Mortise and Tenon, Dowel Joints.
Use of tools – plier, grinder, saw.
Developing creative thinking.
Basic drawing and visualisation skills including 2D to 3D - Form exploration.
Principles of animation.
Technical aspects of animation and film making (Frame rate, persistence of vision).
Building a Narrative – Start, Middle and End of a story.
Mediums of animation.

Course Title and Course Code	**Mechanical Engineering CAD Lab (ME1107)**
Hours per Week	**L T P: 0 0 2**
Credits	**1**
Students who can take	**B. Tech Semester-IV ME**

Course Objective:
To develop competencies in machine drawing to create blue prints.

Learning Outcomes:

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

1. identify surface roughness number and symbol, symbols of machine elements and welded joints limit.
2. assess limits, fits and tolerance for machine elements in engineering drawings.
3. develop geometrical models for different machine components.
4. develop assembly and detailed drawings of engine parts.

Prerequisites		**Basics of Physics**		
Sr. No	**Specifications**	**Marks**	**S#1**	**S#2**
1	Attendance	5	5	5
2	Assignment	25	25	25
3	Class Participation	NIL	NIL	NIL
4	Quiz	NIL	NIL	NIL
5	Theory Exam-I	NIL	NIL	NIL
6	Theory Exam-II	NIL	NIL	NIL
7	Theory Exam-III	NIL	NIL	NIL
8	Report-I	NIL	NIL	NIL
9	Report-II	NIL	NIL	NIL
10	Report-III	NIL	NIL	NIL
11	Project-I	40	40	40
12	Project-II	NIL	NIL	NIL
13	Project-III	NIL	NIL	NIL
14	Lab Evaluation-I	15	15	15
15	Lab Evaluation-II	15	15	15
16	Course Portfolio	NIL	NIL	NIL
Total (100)		**100**	**100**	**100**
Evaluation Scheme for Retest		**Marks**		
1	Lab Evaluation-Retest	30	30	30
Total		**30**	**30**	**30**

COURSE SYLLABUS (Theory):

UNIT - I

Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints.

Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, commonly used holes and shafts.
Fasteners: Drawings of various views of Screw threads, metric and BSW threads, Square thread and multi start threads. Nuts & bolts, Washers, Setscrew, Locknuts and foundation bolts.

UNIT - II
Drawings of various views of:
Shaft joints: Cotter joint and Knuckle joint.
Keys & Shaft coupling: Muff, Flanged, Flexible, Universal and Oldham's coupling.
Shaft bearing: Solid and bush bearing, Plummer block.
Pipe Joint: Flanged joint, Socket and Spigot joint, Hydraulic joint, Union joint, Expansion joint.
Pulley: V-belt pulley.
Gears: Spur gear in mesh with approximate construction of tooth profile, Rack and pinion.

UNIT – III
Assembly and detailed drawings of Engine Parts: Piston, stuffing box, cross head, Vertical & Horizontal engine, Connecting rod, Crank.
Valves: Steam stop valves.

Text & Reference Books:

1. Engineering Drawing: N.D.Bhatt & M.Panchal 37th Edition 1996, charotar publishing House Gujarat
2. Machine Drawing – P. S. Gill S.K. Kataria & Sons Delhi.
3. Engineering Drawing & Design: Cencil Jensen, Jay D. Helsel, Dennis R. Short, Seventh Edition, Tata Mcgraw Hill 2012
4. "Engineering Graphics" by K.L. Narayana and P.Kannaiah, scitech publications (india) pvt.ltd. october 2008
5. Engineering Drawing: K.R. Gopal Krishna, 24 th Edition 1999 Subhash publications, Bangalore

Course Title and Course Code	**Computer Aided Modeling and Simulation (ME1206)**
Hours per Week	**L T P: 1 0 2**
Credits	**2**
Students who can take	**B. Tech Semester-IV & VI ME**

Course Objective:

To develop competencies in CAD modeling and simulation for effective concurrent engineering.

Learning Outcomes:

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

1. design mechanical parts using CAD software.
2. assess the use of tool to create, constrain, and edit sketched features.
3. assess the use of modeling & assembly tools to create and constrain components.
4. generate simulation results for any machine part and assembly.

Prerequisites		**Basics of Physics**		
Sr. No	**Specifications**	**Marks**	**S#1**	**S#2**
1	Attendance	5	5	5
2	Assignment	25	25	25
3	Class Participation	NIL	NIL	NIL
4	Quiz	NIL	NIL	NIL
5	Theory Exam-I	NIL	NIL	NIL
6	Theory Exam-II	NIL	NIL	NIL
7	Theory Exam-III	NIL	NIL	NIL
8	Report-I	NIL	NIL	NIL
9	Report-II	NIL	NIL	NIL
10	Report-III	NIL	NIL	NIL
11	Project-I	40	40	40
12	Project-II	NIL	NIL	NIL
13	Project-III	NIL	NIL	NIL
14	Lab Evaluation-I	15	15	15
15	Lab Evaluation-II	15	15	15
16	Course Portfolio	NIL	NIL	NIL
	Total (100)	**100**	**100**	**100**
Evaluation Scheme for Retest		**Marks**		
1	Lab Evaluation-Retest	30	30	30
Total (30)		**30**	**30**	**30**

COURSE SYLLABUS:

UNIT – I

Introduction to 2-D & 3-D Modeling:

Creating a New Part File, Sketched Base Features, Primitive Base Features, Sketch Geometry, Advanced Editing Tools, Rectangle & Circular Sketch Patterns, Over-Dimensioned Sketches,

Sketch Preferences, Extruded Secondary Features, Revolved Secondary Features, Using Existing Geometry, Editing Sketched Secondary Features, Edge Chamfer, Constant Fillets, Variable Fillets, Face Fillets, Full Round Fillets, Straight Holes, Threads, Creation Sequence, Section Views.

UNIT - II

Advance 3-D modeling and Assembly:

Creating a New Part, Rail Lofts, Center Line Lofts, Advanced Loft Options, Rectangular Feature Patterns, Circular Feature Patterns, Mirror Parts or Features, Manipulate Patterns and Mirror Features, Assembling Components using Constraints, Content Center, Assembly Browser, Assembling Components using Joints, Moving and Rotating Assembly Components, Selection Options in Assemblies, Measurement Tools, Model Properties, Assembly Parts, Assembly Features.

UNIT - III

Surfacing, and Drafting:

New Drawing Views, Manipulating Views, Dimensions, Drawing Sheets, Parts List, Balloons, Styles and Standards, Hatching, Text, Symbols, Hole and Thread Notes, Chamfer Notes, Center Marks and Center Lines, Hole Tables, Revision Tables and Tags.

UNIT - IV

Static & Dynamic Simulation

General Working of FEA, Nodes, Elements, General Procedure of Conducting Finite Element Analysis

through inventor, Structural Analysis, Material Properties, Mesh Generation, Mesh Density, Defining the New Analysis Type, Restarting the Analysis, Setting Analysis Options, Solving the Analysis Problem, Dynamic Analysis.

Text Books:

1. Tickoo, Sham. Autodesk Inventor 11 For Engineers & Designers (With Cd). Dreamtech Press, 2006.
2. Shih, Randy. Parametric Modeling with Autodesk Inventor 2014. SDC Publications, 2013.
3. Bethune, James D. Engineering Design Graphics with Autodesk Inventor 2020. Macromedia Press, 2019.
4. Zeid, Ibrahim. CAD/CAM theory and practice. McGraw-Hill Higher Education, 1991.

Course Title and Course Code	**Theory of Machines (ME1108)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
O Students who can take	**B. Tech Semester-V (Batch: 2018-2022)**

Course Objective:

This course aims to impart knowledge on design and analysis of mechanism for the specified type of motion in a machine and transmission systems.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Compare and develop various application based linkages and mechanisms
2. Analyze velocity and acceleration polygon of different types of mechanisms.
3. Analyze the cam and follower mechanism in order to optimize the power consumption.
4. Prioritize among various mechanisms like belt, rope and chain drive systems in order to minimize energy consumption.

Prerequisites		**Basics of Physics**
Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	10
3	Class Participation	NIL
4	Quiz	20
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

Evaluation scheme for Re-test

Sr. No	**Specifications**	**Marks**
1	Theory Exam-III (Re-test)	30
Total (30)		**30**

COURSE SYLLABUS (Theory):

UNIT - I

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms

(8 lectures)

UNIT - II

Kinematic Analysis of Mechanisms:

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics Coincident points- Coriolis component of acceleration- introduction to linkage synthesis three position graphical synthesis for motion and path generation. **(12 lectures)**

UNIT - III

Cams: Classification of cams and followers- Terminology and definitions- Displacement diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers. **(12 lectures)**

UNIT – IV

Belts, Ropes and Chains: Mechanism of belt, rope and chain drive, power transmitting capacity, effect of centrifugal forces, material used for Belts, rope and chain.

(4 lectures)

Vibration: Introduction to vibration, single degree of freedom (free Vibration)

(4 lectures)

COURSE SYLLABUS (Practical):

1. (i) To study the various types of link, and pair mechanism.
   (ii) To study the inversions of four bar mechanism.
2. To determine whirling speed of shaft theoretically and experimentally.
3. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
4. To determine the natural frequency of un-damped torsional vibration of a single rotor shaft system.
5. To determine the natural frequency of un-damped torsional vibration of two rotor shaft system.
6. To Analyze the motion of a motorized gyroscope when the couple is applied along its spin axis.
7. To determine the frequency of un-damped free vibration of an equivalent spring mass system.

8. To determine the frequency of damped force vibration of a spring mass system/related case study.
9. To study the static and dynamic balancing using rigid blocks/related case study.
10. To plot follower displacement Vs cam rotation graph for various cam follower arrangement.

Text Books:

1. Rattan S.S, "Theory of Machines" Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 2nd edition -2005.
2. Sadhu Singh, "Theory of Machines," Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2ND Edi. 2006.
3. Jagadish Lal, 'Theory of Machine', Dhanpat Rai Publications, New Delhi.

Reference Books:

1. Shigley. J. V. and Uickers, J.J., "Theory of Machines & Mechanisms" OXFORD University press.2004
2. "Theory of Machines -I", by A.S.Ravindra, Sudha Publications, Revised 5th Edi. 2004.
3. "Theory of Machines ", by Thomas Bevan, CBS Publishers and Distributors.

Course Title and Course Code	**PRODUCTION TECHNOLOGY - II (ME1109)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-V (Batch: 2018-2022)**

Course Objective:

The main objective of the course is to impart knowledge of production technology so that students are able to design and perform various forming and machining processes to shape materials for different applications.

Learning Outcomes:

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

1. Design load capacity of forming equipment to perform various bulk forming and sheet forming operations.
2. Design of machining tools, forming tools and holding tools for various forming and machining processes.
3. Calculate force required for machining metallic materials using appropriate cutting tool materials and cutting fluids.
4. Use cutting, milling, and finishing operations to shape materials and evaluate their surface finish using conventional and automatic machines.

Prerequisites: Basics of Materials Engg, PT-I

Evaluation Scheme

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	20
3	Class Participation	NIL
4	Quiz	20
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

Evaluation Scheme for Re-test		
Sr. No	**Specifications**	**Marks**
1	Theory Exam-III	30
Total (30)		**30**

Course Contents:

UNIT - I

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending), principles of powder metallurgy. **(8)**

UNIT - II

Tooling for conventional and non-conventional machining processes: Mold and die design, Press tools, Cutting tools; **(6)**

Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design. **(6)**

UNIT - III

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, cutting tool materials, Cutting fluids. **(10)**

UNIT - IV

Turning, Drilling, Milling and finishing processes, Surface finish and integrity, Coating. **(8)**

Introduction to CNC machining. **(2)**

Course Syllabus (Practical)

1. Study of single point cutting tool geometry & grind the tool as per given tool geometry / related case study.
2. To prepare a job using lathe machine / related case study.
3. To prepare a gear using Milling Machine / related case study.
4. Study the milling machine, milling cutters, indexing heads and indexing methods / related case study.
5. Prepare a hexagonal / octagonal nut using indexing head on milling machine / related case study.
6. To cut external metric threads & to meet it with the nut / related case study.
7. To prepare the job by eccentric turning on lathe machine / related case study.
8. To prepare a job on shaper from given MS rod / related case study.
9. To prepare a job on surface grinder and measure the various parameters of the finished piece / related case study.
10. Disassembly and assembly of small assemblies such as three jaw chuck, four jaw chuck, tail stock, bench vice, screw jack etc. / related case study.

Text Books and Reference Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black & Kohser, Materials and Processes in Manufacturing
4. Amitabh Ghosh & Mallik, Manufacturing Science, Affiliated East-West Press Pvt Ltd, New Delhi.

Online References:

1. Fundamentals of manufacturing process by NPTEL
   https://swayam.gov.in/nd1_noc20_me67/preview
2. Principles of metal forming technology by NPTEL
   https://swayam.gov.in/nd1_noc20_me72/preview

3. Advanced Manufacturing Process Analysis by Coursera
   https://www.coursera.org/programs/j-k-lakshmipat-university-on-coursera-kzogk/browse?currentTab=CATALOG&index=prod_enterprise_products&productId=9_tBpYquEeatfg7c63n1lQ&productType=course&query=production+technology&showMiniModal=true

Course Title and Course Code	**Mechatronics (ME1207)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-V ME**

Course Objective:

The key objective of this course is to acquaint the students with fundamentals of mechatronics system and its deployment in various hydraulic, mechanical and electrical machines.

Learning Outcomes:

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

1. Identify the use of sensors and transducers in a machine.
2. Select an appropriate control method for a system.
3. Determine the need of signal conditioning for hydraulic, mechanical and electrical systems.
4. Evaluate and implement electrical, mechanical actuators and controllers for various applications.

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	10
3	Class Participation	NIL
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	20
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I (Continuous)	10
15	Lab Evaluation-II (Exam)	10
16	Course Portfolio	NIL
Total (100)		**100**
Evaluation scheme for Retest		**Marks**
1	Theory Exam	30
2	Lab Evaluation	10
Total		**40**

COURSE SYLLABUS (Theory):

Unit 1:

Introduction: Definition of Mechatronics, Mechatronics in manufacturing, products, and Design, comparison between traditional and mechatronics approach, microprocessors and microcontrollers.

Introduction to control systems: open and closed loop controllers, application of mechatronics in industry and home appliances.

Unit 2:

Introduction to sensors and transducers, performance parameters.

Sensor to measure Displacement, velocity, force, fluid pressure, liquid flow, temperature using thermocouples, criteria for selecting sensor for various application.

Unit 3:

Introduction to signal conditioning, Need for signal conditioning, Signal protection, Noise elimination, Wheatstone bridge: Applications with strain gauges, Temperature compensation, Basic system models, Mechanical, electrical, thermal and fluid systems, Rotational-translational systems, Electromechanical systems, Hydraulic-mechanical systems.

Unit 4:

Actuators: Electrical actuators (Relays, contactors and solenoids, Electric motors: AC, DC, stepper), Mechanical actuators (Gears, belt and chain drives, Linkage mechanisms, Ratchet and pawl), Hydraulics and Pneumatics.

Controllers: Various control modes, Proportional control mode, Derivative control mode, Integral control mode, PID controllers.

COURSE SYLLABUS (Practical):

1. Conduct experiments in a virtual environment to deploy sensors for specific task-1.
2. Conduct experiments in a virtual environment to deploy sensors for specific task-2.
3. Conduct experiments in a virtual environment to deploy sensors for specific task-3.
4. Conduct experiments in a virtual environment to deploy sensors for specific task-4.
5. Conduct experiments in a virtual environment to control an electro-mechanical system-1.
6. Conduct experiments in a virtual environment to control an electro-mechanical system-2.
7. Conduct experiments in a virtual environment to control an electro-mechanical system-3.
8. Conduct experiments in a virtual environment to control an electro-mechanical system-4.

Books:

1. Alciatore, David G. Introduction to mechatronics and measurement systems. Tata McGraw-Hill Education, 2007.
2. Nakra, B. C. Theory and applications of automatic controls. New Age International, 2005.
3. Bolton, W. Mechatronics (Anna University): A Multidisciplinary. Vol. 10. Pearson Education India, 2008.
4. Bolton, William. Control systems. Newnes, 2002.

Course Title and Course Code	Infrastructure and Urban Planning CE1212
Hours per week	**L T P: 3 0 2**
Credits	4
Students who can take	**B. Tech (V Sem) OE**
Course Objective: To understand various components of infrastructure, their requirements and management. It also includes the planning principles, evaluation, economics and benefit cost ratio of these projects.	

Learning Outcomes:

On completion of the course, the student should be able to:

1. Asses the need of various types of infrastructures in urban areas.
2. Analyze the various types of plans and their implementing agencies.
3. Analyze the various components of water supply, sanitation, transportation and waste management.
4. Analyze the planning of various types of social infrastructure projects.

Evaluation Scheme:

Prerequisites		**None**
Sr. No	**Specifications**	**Marks**
1.	Attendance	Nil
2.	Assignment (4 No.)	20
3.	Class Participation	Nil
4.	Quiz (3 No.)	15
5.	Theory Exam-I	Nil
6.	Theory Exam-II	15
7.	Theory Exam-III	25
8.	Report-I	Nil
9.	Report-II	Nil
10.	Report-III	Nil
11.	Project-I	10
12.	Project-II	Nil
13.	Project-III	Nil
14.	Lab Evaluation-I	5
15.	Lab Evaluation-II	10
16.	Course Portfolio	Nil
Total		**100**
Evaluation scheme for retest		
Theory Exam III		25
Lab Evaluation-II		10
Total		35

COURSE SYLLABUS (Theory):

Introduction to Planning: Defining planning as a discipline, multidisciplinary nature, role of a planner, fields of planning- Urban, regional, environmental, transport and infrastructure, Concepts of garden City, City beautiful, linear city, Various definitions of town and country planning; Goals and objectives of planning; Components of planning; Benefits of planning; Arguments for and against planning. Economics and social planning as bases of physical planning. Planning Process. Levels of planning in India.

Types of Plans: Definition of development plan; Types of development plans: Master plan, City development plan, Structure plan, District plan, Action area plan, Subject plan, Comprehensive planning, Zonal plans, special area development plan e.g. SEZ (special economic zones), SIR (special investment regions).

Water Supply System: Water supply systems and networks, water sources, quality and quantity requirements, collection and water requirement for various land uses; Factors affecting water demand; Storage facilities; Distribution Systems; rainwater harvesting system.

Sanitation, Sewer system and SWM: Sanitation and Sewer System, types of sewers: General considerations, Sewage Disposal and treatment, Low cost appropriate technologies for sanitation, Elements of Solid Waste Management, Best practices for solid waste management.

Transport System Types and characteristics of transport systems; Principles of transport infrastructure planning and, pedestrian and cyclist infrastructure; parking facilities; principles of traffic management, urban mass transport systems

Waste Management System: Types of solid wastes, collection of waste, segregation of wastes, various methods of disposal, energy generation from waste

Social Infrastructure: Typologies; Planning norms and space standards for educational, health, recreational and socio-cultural facilities; amenities for urban settlements.

Lab Syllabus:

1) Introduction to Auto CAD
2) Symbols used in Civil Engineering drawing, Masonry Bonds.
3) All 2D and 3D commands with short keys
4) Practice exercises on AUTOCAD software
5) Drawing of plans of buildings using software (a) Single storied buildings (2D drawing)

Text books:

1. Hutchinson, B.G., Principles of Urban Transport Systems Planning, Scripta, McGraw-Hill, New York, 1974.
2. Claire, Hand Book of Urban Planning, Van Nostrand Book Company, 1974.
3. Gallian, B. Arthur and Simon Eisner, The Urban Pattern - City Planning and Design, Affiliated Press Pvt. Ltd., New Delhi, 1985.
4. Roberts M., An Introduction to Town Planning Techniques, Hutchinson, London, 1980.

5. Hiraskar, G. K., Fundamentals of Town Planning, Dhanpat Rai Publications, 1992
6. Grigg, Neil, Infrastructure Engineering and Management, Wiley, (1988).

Course outline

Course Title and Code – Understanding and Managing Conflict| CC1105|Semester- V

Course Description

In today's increasingly complex and fragmented world, it is important to be able to resolve conflicts and build healthy relationships. Interpersonal and Group Dynamics is a course designed to prepare students to identify conflicts, manage emotions, analyze the situation and characters, and practice different frameworks to deal with conflicts.

Learning Outcomes

The students will be able to:

- Define a group and explain the stages of group development
- Describe conflict and explain types and causes of conflict
- Use inquiry and advocacy to engage with groups
- Give and receive feedback effectively
- Identify sources of conflict and manage them using difference conflict handling styles

Prerequisites		**N/A**
Hours per Week		**L-T-P: 2-0-0**
Credits		**2**
Sr. No	**Specifications**	**Marks**
1.	Attendance	Nil
2.	Assignment	30
3.	Class Participation	20
4.	Quiz	20
5.	Theory Exam-I	Nil
6.	Theory Exam-II	Nil
7.	Theory Exam-III	30
8.	Report-I	Nil
9.	Report-II	Nil
10.	Report-III	Nil
11.	Project-I	Nil
12.	Project-II	Nil
13.	Project-III	Nil
14.	Lab Evaluation-I	Nil

15.	Lab Evaluation-II	Nil
16.	Course Portfolio	Nil
	Total (100)	100

Course Content

1. Introduction to the stages of group development
2. Introduction to Personality, Perception and Learning as source of differences in individual and groups
3. Nature, Types and sources of Conflict
4. Conflict Resolution Strategies
5. Emotional Intelligence
6. Empathy and Feedback
7. Inquiry & Advocacy – Concept of silence (Masking, Avoiding, Withdrawing) and violence (Controlling, Labeling, Attacking)

References for Reading:

1. Fisher, R., & Ury, W. (2011). Getting to yes: Negotiating agreement without giving in. Toronto, ON: Penguin Random House.
2. Harper, G. (2004). The joy of conflict resolution: Transforming victims, villains and heroes in the workplace and at home. Gabriola Island, BC: New Society Publishers.
3. Miles, E. W. (2013). Developing strategies for asking questions in negotiation. Negotiation Journal, 29(4): 383–412. doi: 10.1111/nejo.12034.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
EE1111	Introduction to Internet of Things (IoT)	1	0	2	0	2

Course Objectives:

The course aims to develop understanding of Internet of Things concepts and working on IoT development boards to interface sensors and actuators. The course will enable the students to upload data from sensors on a web server and to use this data for analytical purposes or to actuate some transducers.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Interface the Analog and Digital sensors to Node-MCU
2. Develop Embedded C programs to read sensor data and upload to public cloud platform.
3. Use Python-based IDE (integrated development environments) for the Raspberry Pi
4. Interface Raspberry Pi with I/O devices.
5. Visualize sensor data uploaded on public cloud.
6. Apply standard protocol(s) for implementation of IoT Systems.
7. Analyze and Improve existing systems with innovative IoT based approaches.

Assessment Scheme:

Prerequisites		**Basic Programming**
Teaching Scheme (Hours per Week)		L T P 1 0 2
Credits		2
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NA
2	Assignment	NA
3	Class Participation	NA
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	NA
7	Theory Exam-III	20
8	Report-I (Case Study on Raspberry Pi, IoT)	20
9	Report-II	NA
10	Report-III	NA
11	Project-I	NA
12	Project-II	NA
13	Project-III	NA
14	Lab Evaluation-I (Continuous)	30
15	Lab Evaluation-II	NA
16	Course Portfolio (MOOC certificate)	10
	Total (100)	100
Evaluation Scheme for Retest		

	1	Theory Exam-III	20	
	2	Lab Evaluation-II	0	
		Total (40)	20	

Course Syllabi (Theory):

UNIT 1: Introduction to IoT Fundamentals: Definition, Characteristics, Applications, Connectivity Layers, Addressing, Networking.

UNIT 2**:** Sensors and Actuators: Sensors and Transducers, Sensor Classes, Sensor Types, Actuator Basics, Actuator Types,

UNIT 3**:** Basics of IoT Networking & Protocol: IoT Components, Inter-dependencies, SoA, Wireless Networks, Protocol Classification, MQTT, Secure MQTT, CoAP, XMPP, AMQP (Advanced Message Queuing Protocol)

UNIT 4**:** Connectivity Technologies: IEEE 802.15.4, ZigBee, 6LoWPAN, RFID, HART, NFC, Bluetooth, Zwave.

UNIT 5**:** Introduction to NodeMCU and Server: Basic Concepts of Arduino Platform, Examples of Arduino Programming, Interfacing different sensors with NodeMCU. Introductio to Blynk App, Uploading and downloading data from server using Blynk App. Intoduction to ThingSpeak Server, Uploading and downloading data from ThingSpeak server.

UNIT-6 Raspberry Pi: Basic functionality of the Raspberry Pi B+ board, Setup and Configuring Raspberry Pi, programming on the Raspberry Pi using Python, Python functions to access the Raspberry Pins, how Raspberry Pi interact with online services through the use of public APIs and SDKs, case studies.

References:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
3. Rajkamal, Internet of Things, Architecture and Design Principles, Mc. Graw Hill Education (India) Pvt Ltd.
4. IoT fundamentals: networking technologies, protocols, and use cases for the internet of things : Hanes, David | Salgueiro, Gonzalo | Grossetete, Patrick | Barton, Robert Henry, Jerome, Pearson, 2018, ISBN: 9789386873743.
5. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning IOT by David Etter,

Video lectures:

1. Introduction to internet of things By Prof. Sudip Misra, IIT Kharagpur
   https://swayam.gov.in/nd1_noc20_cs66/preview
2. https://www.coursera.org/specializations/iot#courses

3.	https://www.coursera.org/specializations/embedding-sensors-motors MOOC course The Arduino Platform and C Programming https://www.coursera.org/learn/arduino-platform?specialization=iot#syllabus	

Course code	Course Title	Teaching Scheme	
		NA	Credits
PR1101	Automation Project		2

Course Objectives: The course aims to train students for designing and implementing solutions for Automation using Internet of Things.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Design and implement a complete project in IoT using Node-MCU and sensors using Embedded C programs

   Or

   Design and implement a complete project in IoT using Raspberry pi and sensors using Python programs
2. Apply one/more standard protocol(s) during project implementation
3. Demonstrate sensitivity to sustainability issues for power consumption / Bandwidth utilization/economic solutions during implementation of projects**.**

Assessment Scheme:

Sr. No.	Evaluation Component	Marks
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	Nil
4	Quiz	Nil
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III	Nil
8	Report I (Synopsis)	30
9	Report II (Midterm Progress Presentation and Viva)	30
10	Report III	Nil
11	Project I (with Report)	Nil
121	Project II	Nil
13	Project III (With working model)	40
14	Lab Evaluation I	Nil
15	Lab Evaluation II	Nil
16	Course Portfolio	Nil
	Total (100)	**100**
Evaluation scheme for retest.		
	Project III (with Report)	**40**
	Total (100)	**40**

Course code		Course Title	Teaching Scheme			
			L	T	P	Credits
PS1101		Practice School – I				4
Evaluation Scheme						
S. No.	Evaluation Component		Marks (100) (Weightage %)			
1	External Supervisor	Day to Day task Record	30			
		Report Content and Presentation	20			
2	Faculty Supervisor	Reporting Activity Fortnightly	20			
		Presentation, Viv, Report	30			

Syllabus:

This course is for 6 weeks at the end of 4th semester during summer term of 4 year full time B. Tech. and 5 year Integrated Dual degree (B.Tech + M.Tech, B.Tech + MBA) programs in all the engineering disciplines. The objective of this Programme is to provide the students an understanding of working of corporate world in various functions associated with an Industry/Organization. During this Programme, they will observe and learn various real-world applications of their curricula and develop an understanding of vast engineering operations and its various facets such as inventory, productivity, management, information systems, human resource development, data analysis etc. The general nature of PS-1 assignments is of study and orientation.

Course Title and Code	Design of Machine Elements- ME1110
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	**B. Tech Semester-VI (Batch: 2017-2021)/ Core**

Course Objective: This course aims to equip students with the concepts, procedure, and standards for designing and evaluating shafts, bearings, springs, and gears for different applications.

After course completion, the student will be able to:

1. Design and evaluate shafts to work under different service loading conditions as per ASTM/BIS standards.
2. Design bearings for various applications as per ASTM/BIS standards.
3. Design, evaluate gears for various applications as per ASTM/BIS standards.
4. Design springs for various systems as per ASTM/BIS standards.

Prerequisites	Strength of Materials and Engineering Mechanics.		
Sr. No	**Specifications**	**Marks**	**Marks (Post COVID)**
1	Attendance	NIL	
2	Assignment	10	20
3	Class Participation	NIL	
4	Quiz	10	20
5	Theory Exam I	10	10
6	Theory Exam II	10	
7	Theory Exam-III	30	20
8	Report-I	NIL	10
9	Report-II	NIL	
10	Report-III	NIL	
11	Project-I	10	
12	Project-II	Nil	
13	Project-III	Nil	
14	Lab Evaluation-I	10	10
15	Lab Evaluation-II	10	10
16	Course Portfolio	Nil	
	Total (100)	**100**	**100**

Syllabus (Theory)

UNIT-I

Design for Fluctuating Loads- Theory of failures, cyclic stress, fatigue and endurance limit, stress concentration factor, notch sensitivity, design for finite and infinite Life, Soderberg, Goodman & Gerber criteria.

Shafts- Material for shaft, stresses in shaft, design of shaft subjected to twisting moment, bending moment and combing twisting and bending moments, shaft subjected to fatigue load.

UNIT-II

Bearing- Classification of bearing, hydrodynamic lubrication, sliding contact bearing, design of journal bearing, thrust bearing-pivot and collar bearing, hydrodynamic thrust bearing.
Rolling contact bearing, types of rolling contact bearing, Bearing life, Selection of ball and roller bearings with ABMA Standards.

UNIT-III

Spur Gears- classification of gear, tooth forms, system of gear teeth, design consideration, Beam strength of gear tooth, dynamic tooth load, wear strength of gear tooth, failure of gear tooth, design of spur gears, AGMA standards.
Helical Gears: Terminology, forces components on a tooth of helical gear, virtual number of teeth, beam strength & wear strength of helical gears, dynamic load on helical gears.

UNIT-IV

Springs- Types of springs, design for helical springs against tension, compression and fluctuating loads, Design of leaf springs, Surging phenomenon in springs.

Text Book(s)

1. Joseph Edward Shigley. "Mechanical Engg. Design" Tata Mc Graw Hill Book Co., 2006.
2. Bhandari, V B "Design of Machine Elements" Tata McGraw Hill, New Delhi., 2000.
3. PSG College of Engg. "PSG Design Data Book". PSG Publication.
4. K. Balveera Reddy & K. Mahadevan. "Design Data Handbook". 4th ed. CBS Publishers & Distributors, 497 pages, 2013.

Reference Book(s)

1. Dieter, G.E. and L.C. Schmidt, *Engineering Design*, 5th ed., McGraw-Hill Book Co, 825 pages, 2012.
2. Chitale, A. K., and R. C. Gupta. Product design and manufacturing. PHI Learning Pvt. Ltd., 2011.
3. Norton, Robert L. Machine Design An Integrated Approach. Pearson., 2006.
4. Kulkarni, S G . Machine Design. New Delhi: Tata Mcgraw Hill., 2008.

Syllabus (Lab)

1. Design an Oldham coupling and develop a 3D model.
2. Design a roller bearing and develop a 3D model.
3. Design a sliding contact bearing and develop a 3D model.
4. Design a spur gear and develop a 3D model.
5. Design a helical gear and develop a 3D model.
6. Design of spring under given condition and develop a 3D model.

Course Title and Course Code	**Automobile Engineering (ME1111)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VI**

Course Objective:

The main objective of the course is:-

1. To make the student conversant with fundamentals of automotive systems
2. To develop competencies in performance analysis of vehicles

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Identify different part of the automobile.
2. Design and explain the working of various parts like engine, transmission, clutch and brakes.
3. Design a steering and suspension system.
4. Identify Euro6 standards for automobile emissions.

Prerequisites		**Thermodynamics**
Sr. No	**Specifications**	**Marks**
1	Attendance	0
2	Assignment	20
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	25
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**
Evaluation scheme for Retest		**Marks**
1	Theory Exam-Retest	**30**
	Total(30)	**30**

UNIT-I **(10 Hours)**

Introduction: Layout of automobile – introduction chassis and body components. Types of Automobile engines. – Power unit – Introduction to engine lubrication – engine servicing

Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.
C.I. Engines: Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction CRDI and TDI Systems.

Unit II **(10 Hours)**

Cooling System: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling – pressure sealed cooling – antifreeze solutions.
Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.
Electrical System: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

UNIT-III **(10 Hours)**

Transmission System: Manual transmission and types of gear box, sliding-mesh, constant-mesh and synchromesh gear boxes, types of dog clutches, gear shift mechanism, principles of automatic transmission. Clutch operation and types, multi-plate and cone clutches, clutch construction and lining. Propeller shafts, universal joints, slip joint, Hotch-Kiss drive and torque tube drive, transaxle and transfer case, radius rods, four wheel drive arrangement. Automobile emissions, their harmful effects, pollution control measures, catalytic converters, exhaust system layout, mufflers, and resonators. Engine parameters, brief discussion of testing devices, engine service, engine tuning, engine re-boring, cyaniding, nitriding, de-carbonization.

UNIT-IV **(10 Hours)**

Braking System: Braking systems, layouts for mechanical braking, hydraulic braking, pneumatic braking, master cylinder, wheel cylinder, tandem cylinder, shoe brakes, disc brakes, requirements of brake fluid, power brakes, concept of ABS and traction control, parking brakes. Steering system, principles and need of steering, components parts, steering gear, steering ratio, steering lock, turning radius, centre point. Steering, wheel geometry, power steering principle and typical schemes.
Suspension System: Suspension system, functions of suspension, component parts, coil springs, leaf springs, air springs, shock absorbers, torsion bars, stabilizer bars, typical combinations of components in suspension systems, MacPherson strut suspension, its merits.
Wheel and tyres, wheel assembly and parts, pressed wheels and cast wheels, wheel rim, tyres, aspect ratio, tyres with tubes and tubeless tyres, advantages, construction of a tyre, plies, radial plies, tyre treads and tyre specifications.

Text Books:

1. Automotive Chassis- Heldt .P. M, Chilton Co., (Nyack, N.Y., P.M. Heldt, 1945) Literary Licensing, LLC, 2012.
2. Automotive Mechanics- N.K. Giri, 8th Edition, Khanna Publications, New Delhi, 2008.

3. Automobile Engineering / William H Crouse
4. Text Book Automobile Engineering–Manzoor, .Nawazish Mehdi & .Yosuf Ali, Frontline Publications.
5. Kamaraju Ramakrishna, “Automobile Engineering”, PHI Learning, New Delhi, 1st Print, 2012.
6. Jain &Asthana, “Automobile Engineering”, Tata McGraw-Hill, New Delhi, 2002.

Reference Books:

1. Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner
3. Automotive Engineering / Newton Steeds & Garrett
4. Automotive Engines / Srinivasan
5. Text Book of Automobile Engineering By Khalil U Siddiqui New Age International
6. Heinz Heisler, “Advanced Vehicle Technology”, Elsevier, New Delhi, 2011.
7. Crouse &Anglin, “Automotive Mechanics”, Tata McGrawHill, New Delhi, 10th Edition 2007.

Course Title and Course Code	**Computer Aided Product Design and Manufacturing (ME1210)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VI (Batch: 2018-2022)**

Course Objective:

This course aims to expose the students with various aspects of Industrial Design & Manufacturing, so as to design new products considering aesthetics, manufacturing cost, environment and other human factors.

Learning Outcomes:

On successful completion of this course, the students should be able to:

5. Identify and select product cycle for any component or assembly.
6. Develop 3D model of the parts as per the dimensional values.
7. Create tool path and machining product using 3-axis CNC Lathe.
8. Create tool path and machining product using multi-axis CNC milling machine.

Evaluation Scheme

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	10
3	Class Participation	NIL
4	Quiz	20
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	10
16	Course Portfolio	10
Total (100)		**100**

Evaluation scheme for Re-test

Sr. No	Specifications	Marks
1	Theory Exam-III (Re-test)	30
Total (30)		**30**

COURSE SYLLABUS (Theory):

UNIT – I

Introduction to CIM**,** Product cycle- Design process- sequential and concurrent engineering, co-ordinate systems, homogeneous coordinates, 2D and 3D transformations.

(9 lectures)

UNIT - II

Curves and Surfaces: Analytical, Synthetic curves with advantages, Disadvantages, Comparison with parametric curves, Geometric modeling curves and surfaces.

Wire frame models, Parametric representations, Parametric curves and surfaces

Solid modeling: Solid models, Fundamentals of solid modeling, Different solid representation schemes, Half -spaces, Boundary representation (B-rep), Constructive solid geometry (CSG), Sweep representation, Analytic solid modeling, Perspective.

(9 lectures)

UNIT - III

3-Axis machining and creating tool path for CNC Lathe: explore tool path for CNC lathe, choose lathe specific tool, Identify the lathe coordinate system, create turning tool path for different turning operations.

(12 lectures)

UNIT – IV

Multi –Axis tool path for CNC Milling Machines: Recognize multi-axis geometry, practice the application of multi-axis tool path, identify 2+3 axis simultaneous machining.

(12 lectures)

COURSE SYLLABUS (Practical):

11. Critical analysis of Industrial drawing.
12. Creating the CAD model of intricate parts.
13. Generate the drafting sheet of CAD models.
14. Application of Geometric tolerance and Dimensioning.
15. Generating the CNC tool path for CNC lathe.
16. Generating the CNC tool path for 3-Axis CNC milling.
17. Generating the CNC tool path for Multi-Axis CNC milling.

Books:

4. Mastering CAD/CAM, Ibrahim Zeid, McGraw Hill Education; 2nd edition (7 August 2006).

5. CAD/CAM Paperback, M. Groover, Pearson, Kindle Edition, 2003.

Reference Courses:

1. https://nptel.ac.in/courses/112/102/112102101/
2. https://onlinecourses.nptel.ac.in/noc20_me44/preview

Course Title and Course Code	**Refrigeration and Air Conditioning (ME1205)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech (Semester-VI)**

Course Objective:

The main objective of the course is: -

- To familiarize with the terminology associated with refrigeration systems and air conditioning
- To develop understanding of basic refrigeration processes.
- To develop the skills required to model, analyze and design different refrigeration as well as air conditioning processes and components

Learning Outcomes:

On successful completion of this course, the students should be able to:

- Design an HVAC technology and innovate schematic designs and the goals of HVAC systems
- Asses the principles and practice of thermal comfort
- Design and assess the practical requirement of a Ventilation system
- Develop generalized psychometrics of moist air and apply to HVAC processes
- Assess refrigerant safety as per ASHRAE standards

Prerequisites	**Thermodynamics, Heat Transfer**

Sr. No	**Specifications**	**Marks**	**Marks (Post COVID)**
1	Attendance	0	
2	Assignment	10	20
3	Class Participation	NIL	
4	Quiz	5	10
5	Theory Exam-I	20	10
6	Theory Exam-II	NIL	
7	Theory Exam-III	30	30
8	Report-I	NIL	10
9	Report-II	NIL	
10	Report-III	NIL	
11	Project-I	15	
12	Project-II	NIL	
13	Project-III	NIL	
14	Lab Evaluation-I	10	10
15	Lab Evaluation-II	10	10
16	Course Portfolio	NIL	
Total (100)		**100**	**100**
Evaluation Scheme for Retest		**30**	
1	**Theory Exam-Retest**	**30**	
	Total (30)	**30**	

COURSE SYLLABUS (Theory):

UNIT-I (10 Lectures)
Introduction: Concept of heat Engine, heat pump and refrigeration, efficiency and COP, Ideal refrigeration cycle–Reverse Carnot cycle, Unit of refrigeration, refrigeration effect, different types of refrigeration systems. Air refrigeration system, air refrigerator, Bell Coleman cycle, Reverse Brayton cycle–ideal and actual cycle's analysis. Air cycles for aircraft – simple system, Bootstrap system. Regenerative system, Reduced Ambient system, concept of dry air rated temperature.

UNIT-II (10 Lectures)
Simple saturated vapor compression refrigeration system, limitation of reversed Carnot cycle with vapor as a refrigerant, pressure- volume, temperature–entropy diagram, pressure–enthalpy diagram, Actual vapor compression cycle and deviation from ideal conditions and their effects on cycle performance, use of tables and charts for solving problems, production of low temperature - compound vapor compression and cascade systems.

UNIT- III (10 Lectures)
Vapor absorption refrigeration systems, principles, different refrigerants–absorbent combination, ideal and actual systems, ideal COP of absorption refrigeration systems, solar refrigeration. Refrigerants types, designation of refrigerants, their properties, desirable properties of an ideal refrigerants, selection of refrigerants, impact of refrigerants on global warming and ozone depletion, global warming potential and ozone depletion potential, environmentally friendly refrigerants, secondary refrigerants and its applications.

UNIT- IV (10 Lectures)
Refrigeration and Air Conditioning Equipment's: Types of compressors, condensers, expansion devices, evaporators; Cooling and Dehumidifying coils, Temperature sensors, Filters, Pressure sensors, Humidity sensors, Actuators, Safety controls; Accessories.

Text Books/References: -

1. Refrigeration & air conditioning – Arora, TMGH
2. Basic refrigeration – Dosat, MGH
3. Fundamentals of heat & mass transfer – Dewitt, JW
4. Heat Transfer, J.P. Holman, MGH
5. W.F. Stocker and J.W. Jones "Refrigeration & Air conditioning" TMH, New Delhi.
6. Manohar Prasad "Refrigeration & Air conditioning" Wiley Estern limited, New Delhi.

Course Title and Course Code	**Element of Stress Analysis (ME1202)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VII ME**

Course Objective:

The key objective of this course is to acquaint the students with fundamentals of stress and strain for 1- D, 2-D, and 3-D systems, factors cause failure and theories to avoid failure, transducers to measure the strain and introduction to fracture mechanics.

Learning Outcomes:

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

- Formulate the stress and strain present in any mechanical system.
- Conduct the test to evaluate the behavior of stress and strain
- Conduct experiment to determine 1-D, 2-D, and 3-D stress tensor in a specimen.
- Determine stress and strain using analytical and graphical methods.
- Identify use of transducers for the measurements of strain.
- Analyze the crack propagation and fracture mechanics

Sr. No	Specifications	Marks
1	Attendance	5
2	Assignment	10
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I (Continuous)	25
15	Lab Evaluation-II (Exam)	15
16	Course Portfolio	NIL
Total (100)		**100**

COURSE SYLLABUS (Theory):

Unit I Simple Stresses, Strains & Compound Stresses

Definition/derivation of normal stress, shear stress, and normal strain and shear strain –Stress-strain diagram-Elastic constants –Poisson's ratio –relationship between elastic constants and Poisson's ratio –Hook's law –Strain energy. Introduction to compound stresses, state of stress at a point, General two-dimensional stress system, Principal stresses, and principal planes. Mohr's circle of stresses and Theories of Failure.

Unit II Three-Dimensional Stress and Strain Fields
Introduction to cartesian tensors, Strains: concept of strain, derivation of small strain tensor and compatibility, stress: derivation of Cauchy relations and equilibrium and symmetry equations, airy stress function, plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.

Unit III Introduction to Material Modelling
Constitutive equations: generalized Hooke's law, linear elasticity, material symmetry; boundary value problems: concepts of uniqueness and superposition, introduction to plasticity, elastic constitutive models and plastic models, finite element implementation of these models, thermo-elasticity, 2-d contact problems, computational implementation of theories of failure.

Unit IV Stresses and Strain Measurements
Introduction to strain measurement and related instrumentation strain gage-based transducers, Electric Resistance strain gauges, Calibration of strain gauges, Measuring circuits, arrangements of strain gauge elements (rosettes), Practical set-up for measurement of strains, introduction to optical methods in strain measurements, digital image correlation in dynamic/impact conditions.

Unit V Generalized Problems
Thick cylinder under uniform internal and / or external pressure, rotating disks of uniform thickness, solid disks, circular disk with a hole, stress concentration, introductory fracture mechanics, analysis of cracked bodies, numerical implementation of fracture mechanics.

COURSE SYLLABUS (Practical):

1. To evaluate stress strain curve for tension test on a standard Mild Steel specimen
2. To evaluate stress strain curve for compression test on a standard Mild Steel specimen and compare the result with the tension test.
3. To write a MATLAB program to generate LAME'S ellipsoid
4. To write a MATLAB program to generate principle stress, shear stress of a given element and plot the same.
5. To write a MATLAB program to generate Mohr's Circle of a given element and plot the same.
6. To write a MATLAB program to generate Mohr's Circle of a given element and plot the same.
7. To develop a CAD model in-order to conduct ANSYS analysis on a given specimen.
8. To study the behavior of stress and strain of a given specimen in ANSYS environment.
9. To study the behavior of deformation of a given specimen in ANSYS environment.
10. To perform Fatigue Test on a given specimen in ANSYS environment.

Text Books:

1. Timoshenko, S and Goodier, J. N., "Theory of Elasticity", Tata McGraw Hill, New Delhi,3rd edition, 1970
2. Srinath, L. S., "Advanced Mechanics of Solids", Tata McGraw Hill, New Delhi, 3rd edition, 2010
3. Thomas M. G., Ronald E. S., George. E. M, "Continuum Mechanics for Engineers", 3rd

Edition, CRC Press, Boca Raton, 2009

References:

1. Batra, R. C., “Elements of Continuum Mechanics”, Reston, 2006.
2. George E. M, Schaum's “Outline of Continuum Mechanics”, McGraw-Hill, 1970
3. Dill, Ellis Harold, “Continuum Mechanics: Elasticity, Plasticity, Viscoelasticity”, CRC
4. Press, 2006.
5. Sadhu Singh," Theory of Elasticity" Khanna publisher, 4th edition, 2013
6. Timoshenko, Stephen P., and James M. G., “Theory of elastic stability”, Courier Corporation, 2nd edition, 2009.

Course Title and Code Computational Fluid Dynamics ME1211	
Hours per Week	**L-T-P: 3-0-0**
Credits	**4**
Students who can take	**B. Tech Semester-VI**

Course Objective:

1. Equip students with the knowledge base essential for application of computational fluid dynamics(CFD) to engineering flow problems
2. Provide the essential numerical background for solving the partial differential equations governing the fluid flow
3. Develop students' skills of using a commercial/Open Source software package (ANSYS Fluent/MATLAB/OpenFOAM)

After course completion, the student will be able to:

1. Use CFD tool to simulate the fluid flow and heat transfer phenomena in design and predict the system performance before manufacturing
2. Formulate and analyze differential equations especially Navier stokes and energy equations and use numerical methods for solving the same
3. Evaluate different flow computation methods and make appropriate choice
4. Model flow problem properly within CFD context, using CAD package and meshing tool
5. Use CFD software to model relevant engineering flow problems, postprocessing of the CFD results, Compare with available data, and explain the findings

	Prerequisites	Fluid Mechanics and Heat Transfer
Sr. No	**Specifications**	**Marks**
1	Attendance	0
2	Assignment	10
3	Class Participation	0
4	Quiz	15
5	Theory Exam-I	0
6	Theory Exam-II	15

7	Theory Exam-III	30
8	Report-I	
9	Report-II	
10	Report-III	
11	Project-I	20
12	Project-II	
13	Project-III	
14	Lab Evaluation-I	
15	Lab Evaluation-II	10
16	Course Portfolio	
Evaluation for retest		
1	Theory Exam-III	30
	Total	**30**

Syllabus:

Introduction to Computational Fluid Dynamics and Principles of Conservation: Computational Fluid Dynamics: What, When, and Why? CFD Applications, Numerical vs Analytical vs Experimental, Modeling vs Experimentation. The impact of CFD. The governing equations of fluid dynamics- models of the flow, The substantial derivatives, continuity equation, momentum equation, Energy equation, boundary conditions

Mathematical behavior of partial differential equations- Mathematical classification of Partial Differential Equation, Illustrative examples of elliptic, parabolic and hyperbolic equations, Physical examples of elliptic, parabolic and hyperbolic partial differential equations

Basic aspect of discretizations- Pre-processing, Solution, Post-processing, Finite Element Method, Finite difference method, Well posed boundary value problem, Possible types of boundary conditions, Conservativeness, Boundedness, Transportiveness, Finite volume method (FVM), Illustrative examples: 1-D steady state heat conduction without and with constant source term

Finite Volume Method - Some Conceptual Basics and Illustrations through 1-D Steady State Diffusion Problems: Physical consistency, Overall balance, FV Discretization of a 1-D steady state diffusion type problem, Composite material with position dependent thermal conductivity, Four basic rules for FV Discretization of 1-D steady state diffusion type problem, Source term linearization, Implementation of boundary conditions

Discretization of Convection-Diffusion Equations- A Finite Volume Approach: Finite volume discretization of convection-diffusion problem: Central difference scheme, Upwind scheme, Exponential scheme and Hybrid scheme, Power law scheme, Generalized convection-diffusion formulation, Finite

volume discretization of two-dimensional convection-diffusion problem, The concept of false diffusion, QUICK scheme.

Discretization of Navier Stokes Equations: Discretization of the Momentum Equation: Stream Function-Vorticity approach and Primitive variable approach, Staggered grid and Collocated grid, SIMPLE Algorithm, SIMPLER Algorithm

Text Books:

1. PS Ghoshdastidar. "*Computational Fluid dynamics and Heat transfer*", Cengage
2. J. D. Anderson Jr. "*Computational Fluid Dynamics*" McGraw-Hill International Edition.
3. S.V. Patankar "*Numerical Heat Transfer and Fluid Flow*" Hemisphere
4. H.K. Versteeg and W. Malalasekera "*An introduction to computational fluid dynamics: The finite volume method*" Pearson Education

Course Title and Code: Critical Thinking for Decisions at Workplace |CC1106			
Course Description: In today's world, the idea of right and wrong is being challenged by businesses, use of technology, economic conditions, and norms of societies. The relevance of a well-reasoned decision is crucial. This course intends to make students take better decisions keeping in mind purpose, context, and ethics. **Learning Outcomes** The students will be able to: 1. Apply techniques of critical thinking to analyse organisational problems through positive inquiry 2. Describe and analyse appropriate problem-solving and ethical decision-making processes 3. Choose the most effective and logical decision among multiple alternatives 4. Evaluate solutions and anticipate likely risks based on purpose, context and ethics			
Prerequisites		**N/A**	
Hours per Week		**L-T-P: 2-0-0**	
Credits		**2**	
Sr. No	**Specifications**	**Weightage**	
		Original	**Revised**
1	Attendance	Nil	10
2	Assignment	20	30
3	Class Participation	20	10
4	Quiz	Nil	-
5	Theory Exam-II	20	15(Individual viva)
6	Theory Exam-III	30	15 (online mode)
	Presentation	20	20
	Total (100)	100	**100**

References for Readings:

1. Lehrer, J. (2010). How we decide. Houghton Mifflin Harcourt.
2. Heath, C., & Heath, D. (2013). Decisive: How to make better choices in life and work. Random House.
3. Hammond, J. S., Keeney, R. L., & Raiffa, H. (2015). Smart choices: A practical guide to making better decisions. Harvard Business Review Press.
4. Cases and scenario will be shared in the class.

Course Title and Course Code	**POWER PLANT ENGINEERING (ME1203)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VII**

Course Objective:
Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

Learning Outcomes:
On successful completion of this course, the students should be able to:

- Model and compare different boiler's based on high pressure or low pressure
- Draw and construct different power plants based on the working fluid used (diesel, water, etc.)
- Demonstrate various functions of different accessories of boilers
- Critic what would be a sustainable power plant out of all different power plants studies
- Analyze and solve energy and economic related issues in power sectors

Prerequisites		**Basics of Physics**
Sr. No	**Specifications**	**Marks**
1	Attendance	5
2	Assignment	10
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	20
6	Theory Exam-II	NIL
7	Theory Exam-III	40
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

COURSE SYLLABUS (Theory):

UNIT – I
Introduction to power plants and Steam Power Plant: Conventional and Non-Conventional Energy Sources, Load-duration curves and definitions, selection of site for steam power plants, Boiler performance, Rankine cycle, Reheat cycle, Regenerative cycle, Surface condenser performance.

UNIT – II
Diesel Power Plant: Diesel engine performance and operation, Power and mechanical efficiency, m.e.p., s.f.c., volumetric efficiency, Thermal efficiency, relative efficiency, Heat balance.

UNIT – III
Gas Turbine Power Plant: Sterling Cycle, Ericson cycle, Brayton cycle, Advantages and Disadvantages of Gas Turbine Plant, Reheating, Regeneration, Intercooling

UNIT – IV
Solar Energy Power Plant: Solar constant, Solar energy collectors, Photovoltaic power system, solar thermal energy power plant, solar central receiver system, PVsyst project design calculation.**Other Power Plants and economics of power plants:** Geo-thermal power plant, OTEC power plant, Tidal wave power plant. Cost of Electric Energy - Fixed and operating Costs - Energy Rates - Types of Tariffs.

COURSE SYLLABUS (Practical):

1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To prepare heat balance sheet for given boiler.
4. To find power output & efficiency of a steam turbine.
5. To find the condenser efficiencies.
6. To study and find volumetric efficiency of a reciprocating air compressor.
7. To conduct variable speed performance test of a single cylinder diesel engine and prepare the curves (i) bhp, ihp, fhp, vs. speed (ii) volumetric efficiency & indicated specific fuel consumption vs. speed.
8. PVsyst based designing of a solar PV cell project.

Text Books:

1. Nag P.K., “Power plant Engineering”, Tata McGraw-Hill, 2008.
2. R. Yadav, “Fundamentals of power plant engineering”, Central Publishing House,Allahabad,

https://nptel.ac.in/courses/112/103/112103112/

Course Title and Course Code	**Modelling of Engineering Materials (ME1209)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VII (Batch: 2017-2021)**

Course Objective:

The objective of this course is to get good exposure for the students to model the behavior of an engineering materials when subjected to a loading system.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. model and predict behavior of Engineering Materials under various loading conditions.
2. model and predict deformation in the engineering materials under various loading conditions.
3. identify types of composites for various applications.
4. design various application-based metal matrix composites.

Evaluation Scheme:

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	20
3	Class Participation	NIL
4	Quiz	20
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

Evaluation scheme for Re-test

Sr. No	Specifications	Marks
1	Theory Exam-III (Re-test)	30
Total (30)		**30**

COURSE SYLLABUS (Theory):

UNIT – I Modelling of Engineering Materials

Introduction to material modelling, Complexity of material response in engineering, Classification of modelling of material response, Coordinate frame and system, Tensors, Continuum Mech**,** Kinematics, Balance laws, Constitutive relations

Unit 2: Linear Mechanical Models of Material Deformation

Introduction to LMMMD, Linear elastic solid models, Classes of elastic constants, Materials with single plane of elastic symmetry, Isotropic materials, Maxwell model, Kelvin-Voigt model, Time temperature superposition

Unit-3: Introduction to composite

Define Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fiber composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.

Stiffness and Strength of composite: Geometrical aspects – volume and weight fraction. Unidirectional continuous fiber, discontinuous fibers, Short fiber systems, woven reinforcements Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

Unit 4: Metal Matrix Composites

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibers. Effect of reinforcement volume fraction rule of mixtures. Processing of MMC, powder metallurgy process, diffusion bonding, stir casting, squeeze casting, a spray process, Liquid infiltration, measurement of interface properties-applications of MMC in aerospace, automotive industries

Lamina Constitutive Equations, basic assumptions of laminated anisotropic plates. Laminate Constitutive Equations Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina properties from Laminate Tests.

COURSE SYLLABUS (Practical):

1. Study the mechanical behavior (under tensile loading) of fly ash composites
2. Study the mechanical behavior (under fatigue loading) of fly ash composites
3. Study the mechanical behavior (under impact loading) of fly ash composites
4. Study the mechanical behavior (under tensile loading) of aluminum alloy
5. Study the mechanical behavior (under fatigue loading) of aluminum alloy
6. Study the mechanical behavior (under impact loading) of aluminum alloy

Text Books:

1. Autar K. Kaw, Mechanics of Composite materials, CRC Taylor & Francis, 2Nd Ed, 2005.
2. Composite Material Science and Engineering, Krishan K. Chawla, Springer, 3e, 2012.
3. Robert M. Jones, Mechanics of Composite Materials, Taylor & Francis, 1999.

Reference Books:

1. Madhijit Mukhopadhay, Mechanics of Composite Materials & Structures, Universities Press,2004.
2. Michael W, Hyer, Stress analysis of fiber Reinforced Composite Materials, Mc- Graw Hill International, 2009.
3. Fibre Reinforced Composites, P.C. Mallik, Marcel Decker, 1993.
4. Handbook of Composites, P.C. Mallik, Marcel Decker, 1997.

Reference courses:

1. Introduction to Composites https://swayam.gov.in/nD1_noC20_me95/preview

Course Title and Code: Introduction to Aeronautical Engineering (ME1402)		
Hours per	**10–12 (7 weeks)**	
Credits	**4**	
Students who can take	**B. Tech Semester-VII (Core)**	
Course Objective: This course introduces the fundamentals of aeronautics, using a tour through the history of flight, starting with ballooning and continuing to airplanes and helicopters.		
On successful completion of this course, the student should be able to: • identify and model the earth's atmosphere for aircraft design • analyse the aircraft stability, structures, navigation and propulsion • design aircraft wings applying aerodynamics principles • identify and analyse aircraft climb, descend and cruise		
Evaluation scheme		
Sr. No	**Specifications**	**Marks**
1	Attendance	
2	Assignment	15
3	Class Participation	
4	Quiz	15
5	Theory Exam-I (MOOC)	15
6	Theory Exam-II (MOOC)	15
7	Theory Exam-III (MOOC)	30
8	Report-I	10
9	Report-II	
10	Report-III	
11	Project-I	
12	Project-II	
13	Project-III	
14	Lab Evaluation-I	
15	Lab Evaluation-II	
16	Course Portfolio	
		100
	Evaluation scheme for Re-test	
1	Theory Exam-III	30
	Total	**30**

Syllabus:

Module A: Introductory module
Introduction + Ballooning, The International Standard Atmosphere, How aircraft fly, Cockpits & Instruments, **Structural** concepts, **Stability** & Control, Propulsion, Materials & Exploring the limits, Special vehicles Module A: Introductory module

Module B: Aerodynamics

Introduction to Aerodynamics, Compressibility, Viscous flows, Pressure distributions and flow separation, Airfoils, Critical Mach number, Finite wings

Module C: Flight Mechanics

Introduction to flight mechanics, Horizontal flight performance, Climbing and descending flight, The flight envelope

Textbooks:

1. Anderson, "Introduction to Flight", McGraw Hill Education
2. Torenbeek, "Flight Physics" Springer

Reference Course

1. https://www.edx.org/course/introduction-to-aeronautical-engineering-2,TUDelft.
2. https://nptel.ac.in/courses/101/105/101105059/, IIT Kharagpur

Course Title and Course Code	**Internal Combustion Engines (ME1201)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VII**

Course Objective:

The main objective of the course is to give the students an introduction to reciprocating internal combustion engines. It also aims to develop competencies among students for analyzing the performance parameters of the engines.

Learning Outcomes:

On successful completion of this course, the students should be able to:

- Design different types of reciprocating internal combustion engines (ICE), their typical design features and performance characteristics.
- Analyze power cycle efficiencies of internal combustion engines for ideal gas cycles, and air- fuel cycles.
- Design various components of exhaust emissions and demonstrate the mechanisms of emission formation.
- Analyze exhaust emission systems for fuel quality and engine performance.

Prerequisites	**Thermodynamics, Heat Transfer**

Evaluation Scheme

Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	10+10(MOOC's)
3	Class Participation	NIL
4	Quiz	20
5	Theory Exam-I	20
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**
Evaluation scheme for Retest		**Marks**
1	Theory Exam-Retest	**30**
Total (30)		**30**

COURSE SYLLABUS (Theory):

UNIT - I

Air standard cycles: Internal and external combustion engines; classification of I.C. Engines, Cycles of operation in four stroke and two stroke I.C. Engines, Assumptions made in air standard cycle; Otto cycle; diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles; sterling and

Ericsson cycles; air standard efficiency, specific work output, specific weight; work ratio; mean effective pressure; deviation of actual engine cycle from ideal cycle. Problems. **(10)**

UNIT - II

Carburetion, fuel Injection and Ignition systems: Mixture requirements for various operating conditions in S.I. Engines; elementary carburetor, Requirements of a diesel injection system; types of injection systems; petrol injection, Requirements of ignition system; types of ignition systems, ignition timing; spark plug. **(4)**

Combustion in S. I. Engines: Ignition limits, Stages of combustion in SI engine, effect of engine variables on ignition lag, effect of engine variables on flame propagation, rate of pressure rise, abnormal combustion, detonation or knocking, effects of detonation. **(4)**

Combustion in C. I. Engines: Stages of combustion, air-fuel ratio in CI engines, delay period or ignition lag, variables affecting delay period, diesel knock, and methods of controlling diesel knock. **(2)**

UNIT - III

Lubrication and Cooling Systems: Lubrication principles, hydrodynamic lubrication, Functions of the lubricating system, Properties of the lubricating oil, SAE rating of lubricating oils, Service rating of oils, Types of lubrication systems; mist, wet sump and dry sump lubrication systems; engine performance and lubrication, Necessity of engine cooling; disadvantages of overcooling; cooling systems; air-cooling, water cooling; radiators. **(6)**

UNIT – 1V

Engine Testing and Performance: Performance parameters: BHP, IHP, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, volumetric efficiency; specific fuel consumption (BSFC, ISFC), thermal efficiency; heat balance; Basic engine measurements; speed, fuel and air consumption, brake power, indicated power and friction power, heat going to cooling water and exhaust gases; performance curves. Problems. **(8)**

Air pollution from I.C. Engine and Its remedies: Pollutants from S.I. and C.I. Engines, Mechanism of formation of pollutants in SI engines, Exhaust emission, emission of unburnt hydrocarbon. Mechanism of formation of pollutants in CI engines. Methods of emission control; alternative fuels for I.C. Engines. **(8)**

COURSE SYLLABUS (Practical):

1. To study the constructional details & working principles of two-stroke or four stroke petrol engine/related case study.
2. To study the constructional detail & working of two-stroke or four stroke diesel engine/ related case study.
3. To draw valve timing diagram of two stroke/four stroke petrol and diesel engines/ related case study.
4. To find the indicated horsepower (IHP) on multi-cylinder petrol engine by Morse Test/

related case study.

5. To perform constant speed performance test on a single cylinder diesel engine & draw curves of bhp vs fuel rate, air rate, bhp vs mep, mechanical efficiency & sfc/ related case study.
6. To perform variable speed performance test of a single cylinder diesel engine and prepare the curves (i) bhp, ihp, fhp, vs. speed (ii) volumetric efficiency & indicated specific fuel consumption vs. speed.
7. To perform constant speed performance test on a single cylinder petrol engine & draw curves of (i) bhp vs fuel rate, air rate and (ii) bhp vs mep, mechanical efficiency & sfc.
8. To perform variable speed performance test of a single cylinder petrol engine and prepare the curves (i) bhp, ihp, fhp, vs. speed (ii) volumetric efficiency & indicated specific fuel consumption vs. speed.
9. To prepare heat balance sheet on multi-cylinder petrol engine/ related case study.
10. To prepare heat balance sheet on single cylinder diesel engine/ related case study.

Reference:

1. Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGraw Hill, New York.

Course Title and Course Code	**Mechanical Vibration (ME1208)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VII ME**

Course Objective:

The key objective of this course is to acquaint the students with fundamentals of mechanical vibration and its area of application.

Learning Outcomes:

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

- identify types of vibration.
- Create a model for a system and evaluate under free and damped vibrations.
- Create a model for a system and evaluate under forced excited and forced damped vibrations.
- Analyze degree of freedom for any mechanical system.

Evaluation scheme

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	15
3	Class Participation	NIL
4	Quiz	15
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I (Continuous)	10
15	Lab Evaluation-II (Exam)	10
16	Course Portfolio	NIL
Total (100)		**100**
Evaluation scheme for Retest		
1.	Theory Exam	30
2	Lab Evaluation (Exam)	10
Total		40

COURSE SYLLABUS (Theory):

UNIT I

Fundamentals-Importance of Study of Vibrations, Classifications of Vibrations, Free and Forced, Undamped and Damped, Linear and Non-linear, Deterministic and Random, Harmonic Motion,

Vector and Complex Number Representations, Definitions and Terminology, Periodic Functions, Harmonic Analysis, Fourier Series Expansion.

UNIT II

Free and Damped Vibrations-Single Degree of Freedom system, D'Alemberts Principal, Energy Methods, Rayleighs Method, Application of various Methods, Damped Free Vibrations, Logarithmic Decrement, Under Damping, Critical and Over Damping, Coulomb Damping.

UNIT III

Harmonically Excited Vibrations-Forced Damped Harmonic Vibration of Single Degree of Freedom Systems, Rotating Unbalance, Rotor Unbalance, Critical Speeds and Whirling of Rotating Shafts, Support Motion, Vibration Isolation, Energy Dissipated by Damping, Equivalent Viscous Damping, Structural Damping Sharpness of Resonance, Vibration Measuring Instruments.

UNIT IV

Two Degrees of Freedom Systems, principal mode of vibration, combine rectilinear and angular modes, Undamped force vibration with harmonic excitation, vibration absorbers, introduction to critical speed of shaft, introduction to multi degree of freedom system.

COURSE SYLLABUS (Practical):

1. Develop a virtual model-1 to conduct experiments for modal analysis.
2. Develop a virtual model-2 to conduct experiments for modal analysis.
3. Develop a virtual model-3 to conduct experiments for modal analysis.
4. Develop a virtual model-4 to conduct experiments for modal analysis.
5. Develop a virtual model-5 to conduct experiments for modal analysis.
6. Develop a virtual model-6 to conduct experiments for modal analysis.
7. Develop a virtual model-7 to conduct experiments for modal analysis.
8. Develop a virtual model-8 to conduct experiments for modal analysis.

Books:

1. Thomson, William T., and H. Saunders. "Theory of Vibrations with Applications." (1982): 156- 156.
2. Feldman, Michael. Hilbert transform applications in mechanical vibration. John Wiley & Sons, 2011.
3. Rao, Singiresu S. Vibration of continuous systems. Vol. 464. New York: Wiley, 2007.
4. Grover, G. K., and S. P. Nigam. Mechanical vibrations. Nem Chand, 2009.
5. Den Hartog, Jacob Pieter. Mechanical vibrations. Courier Corporation, 1985.

Online course

1. https://nptel.ac.in/courses/112/103/112103112/

Course Title and Code: Minor Project (PR1103)	
Prerequisites	**Nil**
Hours per Week	**L-T-P:**
Credits	**04**
Students who can take	**B.tech. Semester VII**

Course Objective:

In Minor Project, Students are expected to work towards the goals and milestones set in Minor Project. The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. At the end there would be a demonstration of the solution and possible future work on the same problem. The student will have to present the progress of the work through seminars and progress reports. (in continue contact with Faculty Supervisor Assigned)

Operation Procedure

- Student has to devote full semester for Minor Project.
- Student has to report to the Supervisor regularly.
- Seminars s evaluation has to be carried out in the presence of atleast two-member Committee comprising.
- Experts in the relevant area constituted by the Supervisor.
- Final Seminar Report to be submitted has to be in formal hard bound cover bearing of the Institute emblem.

Assessment Scheme:

Sr. No	**Specifications**	**Marks**
01	Attendance	NIL
02	Assignment	NIL
03	Class Participation	NIL
04	Quiz	NIL
05	Theory Exam(Mid Term)	NIL
06	Theory Exam	NIL
07	Theory Exam(Final)	NIL
08	Report-1 (Synopsis) (Panel)	15
09	Report-2	NIL
10	Report-3	NIL
11	Project -1 (Mid Term) (Panel)	20
12	Project -2 (Day to Day work) (Demo, Presentation, Viva, Report)	25
13	Project -3 (End Term) (Panel) (Demo, Presentation, Viva, Report)	40
14	Lab Evaluation – I	NIL
15	Lab Evaluation – II	NIL
16	Course portfolio	NIL
	Total (100)	**100**

PS1102/ PR2107/ PR1105/ PR1104**:**

Practice School-II/ Industrial Project-II / Entrepreneurial Project/ Research Project

Course Syllabus:

This course is for five four and half months (summer and one semester) in VII or VIII Semester. The objective of this programme is to provide the students, an opportunity to work on live projects of corporate world in various fields. During this programme, they will work on real world applications of their curricula through organizational function of their choice. The students are expected to be involved directly in problem solving efforts of specific interest to the host organization. The learning of PS-I will help them in completing PS-II successfully. PS-II duration of internship is 4 - 4.5 months. PS -II Winter internship Dec to May.

Course Code	**Course Title**	**Teaching Scheme**	
		Total Duration	**Credits**
PS1102/ PR2107/ PR1105/ PR1104	**Practice School-II/ Industrial Project-II/ Entrepreneurial Project/ Research Project**	**4 months**	**16**

Evaluation Scheme:			
Expert Evaluation	**Evaluation Component**	**Mid-Term**	**Final Term**
Industry Expert	Day to Day Task Record	20	40
	Report Content & Presentation	10	30
JKLU faculty	Reporting Activity Fortnightly	8	18
	Presentation, Viva, Report	20	50
	PS-2 Coordinator Feedback	2	2
	Total	**60**	**140**