छत्रपति शाहू जी महाराज विश्वविद्यालय, कानपुर

CHHATRAPATI SHAHU JI MAHRAJ UNIVERSITY, KANPUR

(पूर्ववर्ती कानपुर विश्वविद्यालय कानपुर)

Formerly Kanpur University, Kanpur – 208024

A Documentary Support

For

Metric No. – 1.1.1

Programme Outcomes & Course Outcomes

Under the

Criteria - I

(Curriculum Design and Development)

Key Indicator - 1.1

In

Metric No. – 1.1.1

B. Tech. (Mechanical Engineering)

Co-ordinator
Internal Quality Assurance Cell
CSJM University, Kanpur

(Registrar)
C.S.J.M.University
Kanpur

REGISTRAR
C.S.J.M. UNIVERSITY
KANPUR

CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY

KANPUR

SYLLABUS

(B.Tech.)

MECHANICAL ENGINEERING

UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY

SCHOOL OF ENGINEERING & TECHNOLOGY

UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY

SCHOOL OF ENGINEERING & TECHNOLOGY

Vision

To achieve excellence in engineering education, empower students to be technically competent professionals and entrepreneurs with strong ethical values so as to significantly contribute as agents for universal development and societal transformation

Mission

To provide affordable quality education at par with global standards of academia and serve society with harmonious social diversity

To encourage new ideas and inculcate an entrepreneurial attitude amongst the students, and provide a robust research ecosystem

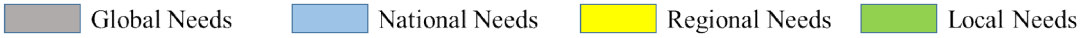
To practice and encourage high standards of professional ethics and accountability among students

Bachelor of Technology in Mechanical Engineering

Program Outcomes (POs)

PO1	**Engineering knowledge:** Apply the knowledge of basic science, mathematics and fundamentals of engineering with specialization to solve the complex problems of engineering.
PO2	**Problem analysis:** Identify and formulate for the analysis of the engineering problems considering the knowledge of engineering mathematics, natural and engineering sciences and review of the research articles and draw conclusion.
PO3	**Design/Development of solutions:** Demonstrate and develop the appropriate solutions of the complex level of mechanical engineering design based problems to meet the specified needs and overall sustainability of the processes, considering the necessary approaches of safety, health hazards, societal and environmental factors.
PO4	**Conduct investigations of complex problems:** Investigate, demonstrate and conduct the design based complex problems using research based knowledge and methodologies, experimental studies, subsequent analysis and interpretation of data to prepare the valid technical reports.
PO5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand and demonstrate the impact of relevant professional engineering solutions and knowledge for the sustainable development of society and environment.
PO8	**Ethics:** Apply suitably the norms and responsibilities of engineering practices towards the commitment following the principles of engineering ethics.
PO9	**Individual and team work:** Work effectively as an individual or in diversified and multidisciplinary environments showing the team solidarity.
PO10	**Communication:** Ability to communicate efficiently with the engineering community, society and able to represent and explain the design documentation effectively with clear instructions.
PO11	**Project management and Finance:** Demonstrate the knowledge and principles of engineering, management, cost and feasibility studies for the desired projects as an individual, a member or leader in a team of multidisciplinary settings.

PO12	**Life-long learning:** Possess the attitude of lifelong independent learning as per the need of wider context of technological changes and can pursue higher education for careers in academics, research and development.



Program Specific Outcomes (PSOs)

PSO-1	Impart education and training of Mechanical Engineering to the students and to eventually make them competent and well qualified Mechanical Engineers
PSO-2	Provide best knowledge of the Mechanical Engineering to the students and nurture their creative talent by motivating them to work on various challenging problems of MechanicalEngineering
PSO-3	Acquire high end industry centric skills in the field of Mechanical Engineering
PSO-4	Knowledge of the software used in the field of Mechanical Engineering
PSO-5	To prepare Professional Engineer with ethical, social and moral values

Program Educational Outcomes (PEOs)

1. To make the students ready for successful career leading to higher education and /or in industry related domains of design, research and development, testing, and manufacturing.
2. To solve diverse real-life engineering problems equipped with a solid foundation in mathematical, scientific, and mechanical engineering principles.
3. To motivate and encourage the students to adopt professionalism, teamwork, leadership, communication skills, ethical approach.
4. To provide learning opportunity in a broad spectrum of multidisciplinary field.

Curricular Components

Category of courses	Credits offered
Basic Science Core	**31**
Engineering Science Core	**30**
Humanities and Social Science Core	**17**
Departmental Core	**76**
Departmental Electives	**16**
Open Electives	**08**
Projects and Seminars	**16**
Total	**194**

Semester-wise Course Structure

Semester – wise breakup of courses

I SEMESTER		L	T	P	Cr
CHM-S101	Chemistry-I	3	1	3	5
ESC-S101	Basic Elect. & Elect. Engg.	3	1	3	5
MTH-S101	Mathematics -I	3	1	0	4
PHY-S101	Physics -I	3	1	3	5
TCA-S102	Workshop Technology	1	1	3	5
UHV- S101	Universal Human value-I	0	0	0	0

II SEMESTER		L	T	P	Cr
MTH-S102	Mathematics-II	3	1	0	4
PHY-S102	Physics-II	3	1	3	5
ISC-S101	Programming and Computing	3	0	3	5
TCA-S101	Engineering Drawing	2	0	3	5
HSS-S101	Communicative English	3	1	0	4

III SEMESTER		L	T	P	Cr
MTH –S201	Mathematics III	3	1	0	4
ESC – S201	Engineering Mechanics	3	1	0	4
ESC – S202	Thermodynamics	3	1	0	4
MEE-S201	Mechanical Design & Drawing	2	0	3	5
MEE-S202	Basic Fluid Mechanics & Rate Processes	3	1	3	5
EVS-S101	Environmental science	2	0	0	2

IV SEMESTER		L	T	P	Cr
MEE –S203	Kinematics and Mechanism	3	1	3	5
MEE- S204	Basic Solid Mechanics	3	1	0	4
MEE- S205	Material Science & Engineering	3	0	3	5
MEE- S206	Material removal Manufacturing Process	3	0	3	5
HSS-S201	Industrial Management	3	0	0	4
UHV-S201	Universal Human value-II	2	1	0	3

V SEMESTER		L	T	P	Cr
MEE-S301	Dynamics of Machines & Vibrations	3	0	3	5
MEE-S302	Material Additive Manufacturing Process	3	0	0	4
MEE-S303	IC Engines	3	0	3	5
MEE-S304	Energy System	3	0	0	4
SST- S201	Summer Training/ Mini Project	0	0	2	2
SMM-S301	Seminar	0	0	2	2

VI SEMESTER		L	T	P	Cr
MEE-S305	Heat Transfer	3	0	3	5
MEE-S306	Design Of Machine Elements	3	1	0	4
MEE-S307	Refrigeration & Air-Conditioning	3	0	3	5
HSS-S301	Professional Communication	1	1	1	2
DPE-S301	Elective-I	3	0	0	4
ODPE-S301	Open Elective-I	3	0	0	4

VII SEMESTER		L	T	P	Cr
MEE-S401	Computer Aided Manufacturing	3	0	3	5
MEE-S402	Industrial Management & Production System	3	0	0	4
HSS-S401	Industrial Economics	3	0	0	4
PRT-S401	B.Tech Project-I	0	0	6	4
SST-S301	Summer Training	0	0	2	2
ODPE-S401	Open Elective-II	3	0	0	4

VII SEMESTER		L	T	P	Cr
MEE-S403	Metrology, Measurements and Control	3	0	3	5
MEE-S404	Gas Dynamics & Turbo Machinery	3	0	3	5
MEE-S405	Computer Aided design	3	0	3	5
PRT-S402	B.Tech Project-II	0	0	6	4
DPE-S401	Elective-II	3	0	0	4

Legends
L = Lecture
T= Tutorial
P= Practical/Presentation/Project
C= Credit
Note:

- Total No. of Lectures in each course should in the range of 40 to 45 per semester if per week three lectures are allotted.

List of Departmental Elective Courses (Mechanical Engineering)

Course Code	Course Name	Course Credits	Number of (weekly		
			Lecture	Tutorial	Practical /Discussion
MEE-S502	Automobile Engineering	4	3	0	0
MEE-S504	Operation Research	4	3	0	0
MEE-S505	Machine Tool Design	4	3	0	0
MEE-S506	Finite Element Methods	4	3	0	0
MEE-S509	Computational Fluid Dynamics	4	3	0	0
MEE-S510	Advanced Solid Mechanics	4	3	0	0
MEE-S511	Advanced Fluid Mech.	4	3	0	0
MEE-S512	Fluid Machinery	4	3	0	0

List of Open Electives offered by various Departments in VI & VII Semester

Name of Departments	OEC-I (even sem.)	OEC-II (odd sem.)
Computer Science Engg.	Data Structures: CSE-S208, 4(3-0-0)	Artificial intelligence: CSE-S528, 4(3-0-0)
	Python: CSE-S524, 4(3-0-0)	Python: CSE-S524, 4(3-0-0)
Electronics Engg.	Power Electronics: ECE-S501, 4(3-0-0)	Micro Processors & Applications: ECE-S304, 4(3-0-0)
Material Science and Metallurgical Engineering	Ceramic materials: MSME-S505, 4(3-0-0)	Application of transport phenomena in metal processing: MSME-S502, 4(3-0-0)
	-	Electrochemical technology in materials processing: MSME-S501, 4(3-0-0)
Mechanical Engg.	Robotics/mechatronics:MEE-S501, 4(3-0-0)	Optimization Method in Engineering: MEE-S507, 4(3-0-0)
	Design and manufacturing of Composites: MEE-S508, 4(3-0-0)	Non-Conventional Energy Resources: MEE-S503, 4(3-0-0)

Detailed Syllabus
1st Year

Course Code: CHM – S101T **Breakup:** 3 – 0 – 0 – 3

Course Name: Chemistry – I

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the concept related to atoms and molecules, chemical bonding coordinate compounds and its applications
CO2	Concept of chemical kinetics, electrochemistry, photochemistry and their applications
CO3	Understand the concept of spectroscopy and its applications in various fields
CO4	Understand the basics of stereochemistry, organic reactions and its mechanism for various types of reactions
CO5	Various experiments helps the student to learn the basics of experiments to apply in day today life as well as in industry

Course Details:

UNIT-I - Atoms and Molecules:

Need for wave mechanical picture of atomic structure [Photoelectric effect, de Broglie concept of matter waves], Derivation of schrodinger wave equation [as an example particle moving in unidimensional potential well]

Chemical Bonding- Orbital concepts in bonding, V.B. and M.O. theory, M.O. diagrams, Intermolecular interactions.

UNIT-II - Reaction Dynamics:

Order, Molecularity, Rate law, Integrated rate equations, Methods of determining of order of reaction, Complex reaction kinetics- chain reactions and reversible reactions in detail, Catalysis and enzyme catalysis

UNIT-III - Electrochemistry:

Arrhenius theory of electrolytic dissociation, Transport number, Kohlrausch's law, Solubility product, Redox reaction, Electrochemical and concentration cells.

UNIT-IV- Stereochemistry:

Introduction, Chirality, Enantiomers, Diastereomers, Projection formula of a tetrahedral carbon, Geometrical isomerism, Conformers

UNIT- V- Spectroscopic Techniques:

General introduction to IR, NMR and Mass spectroscopy

UNIT-VI - Organic Reactions:

Introduction, Electron displacement effects, Organic intermediates, Types of reactions [addition, elimination and substitution reactions]

UNIT-VII - Photochemistry:

Photoexcitation of organic molecules, Jablonski diagram, Laws of photochemistry and quantum yield, Some examples of photochemical reactions, Chemistry of vision and other applications of photochemistry.

UNIT-VIII - Transition Metal Chemistry:

Stucture of coordination compounds corresponding to coordination number up to 6, Tpes of ligands, Isomerism [geometrical, optical, ionization, linkage and

coordination], Theories of bonding in coordination compounds- crystal field theory, Valence bond theory, Chelation.

UNIT-IX - Laboratory Practical Classes:

Text Books and References:

Physical Chemistry-

1. Physical Chemistry, P. Atkins and J De Paul, International student edition , 8th edition, Oxford University Press, (2006)
2. Principles of physical chemistry, B. R. Puri, L.R. Sharma and M.S. Pathania, ShobanLalNagin Chand and Co., Jalandhar, 43 edition, Vishal Publishing ***Co***. (2017)

Organic Chemistry-

1. Organic Chemistry, R. T. Morrison and R.N. Boyd, 6th edition, Prentice hall of India (P) Ltd. New Delhi (2016)
2. A Textbook of Organic Chemistry, ArunBahl and B.S. Bahl, S., 22th edition, S.Chand Publishers, New Delhi (2019)

3.Inorganic Chemistry-

1. Concise Inorganic chemistry, J.D. Lee, 5th edition, (1997).
2. Inorganic Chemistry, J.E. Huyee, E.A. Keiter and R.L. Keiter. 4th edition, Prentice Hall, Upper Saddle River,(2017)

Engineering Chemistry-

1. Engineering chemistry , ShashiChawala, DhanpatRai& Co.(2013)

2. Engineering chemistry , P. C.Jain and Monika Jain. 16th edition,DhanpatRai Publishing Company (2015)

Course Code: CHM – S101P Breakup: 0 – 0 – 3 – 2

Course Name: Chemistry Lab- I

Course Details:

Exp. 01. To estimate the strength of the given unknown solution of Mohr's salt (Ferrous ammonium sulphate ($FeSO_4(NH_4)_2SO_4.6H_2O$) using $KMnO_4$ solution as an intermediate.

Exp. 02. To prepare a sample of p-nitroacetanilide.

Exp. 03. To prepare a sample of Aspirin.

Exp. 04. Preparation of Tris (Thiourea) Copper (I) sulphate.

Exp. 05. Preparation of Hexamine Nickel (II) chloride $[Ni(NH_3)_6]Cl_2$.

Exp. 06. Estimation of commercial caustic soda: Determination of the amounts of

sodium carbonate and sodium hydroxide present together in the given commercial caustic soda.

Exp. 07. Estimation of calcium ions present in tap water.

Exp. 08. To determine the partition coefficient of acetic acid between n-butanol and water.

Exp. 09. To study the photochemical reduction of a ferric salt (Blue printing).

Exp. 10. To determine the viscosity of a given liquid (30% sugar solution) at room temperature using Ostwald's viscometer.

Exp. 11. To separate Ag(I), Hg (I) and Pb (II) ions by paper chromatography and calculate their RF values.

Exp. 12. Understanding reaction kinetics and calculating the rate and order of a reaction.

Exp.13. To study the kinetics of methyl acetate hydrolysis catalyzed by .5N HCl Solution.

Course Code: ESC-S101T **Breakup: 3 –1 – 0 – 3**

Course Name: Basic Electrical & Electronics Engineering

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Predict the behavior of any electrical and magnetic circuits
CO2	Formulate and solve complex AC, DC circuits
CO3	Realize the requirement of transformers in transmission and distribution of electric power and other applications
CO4	Have knowledge of some basic electronic components and circuits
CO5	Understand the basics of diode and transistor circuits
CO6	Understand the working of some I C based circuits
CO7	Study logic gates and their usage in digital circuits

Course Details:

Unit – I
Sinusoidal steady state circuit analysis, voltage, current, sinusoidal &phaser presentation single phase AC circuit – behavior of resistance, inductance & capacitance & their combination, impedance concept of power, power factor.Series & parallel resonance – band width & quality factor. Three phase circuits – phase voltage & current, line & phase quantities, phasor diagram, balanced & unbalanced loads, Measurement of R, L, and C.

Unit –II
Network Theory: Network theorems – Thevenin's, Norton, maximum power transfer theorem, star delta transformation, circuit theory concept – mesh & nodal analysis.

Unit – III
Magnetic circuit concepts: self inductance , magnetic coupling analysis of single tuned & double tuned circuit involving mutual inductance , introduction to transformer.

Unit – IV
Basic Instruments, electrical measurement – measurement of voltage , current , power & energy, voltmeters & ammeter , wattmeter , energy meter , three phase power measurement , electronics instrument – multimeter, CRO(analog & digital),An overview of voltage regulator.

Unit – V
Introduction to basic electronics devices – junction diode, BJT, amplifier, op-amps & instrumentation amplifier with mathematical operation.
Number System: Introduction to binary, octal, decimal & hexadecimal systems, representation of negative numbers, 1's, 2's, 9's, 10's complement and their arithmetic.

Text Books and References:

1. Edward Hughe “Electrical and Electronic Technology”, 10th Edition, Pearson Education Asia, 2019.
2. P. Kothari, I J Nagrath, “Electric Machines”, 5th Edition, Tata McGraw Hill, 2017.
3. P. Malvino, “Electronic Principles”, 7th Edition, Tata McGraw Hill, 2007.
4. A Textbook of Electrical Technology - Volume I (Basic Electrical Engineering) 23Rev Ed Edition, S. Chand Publishing.2020
5. S. K. Bhattcharya, “Basic Electrical and Electronics Engineering”, Pearson, 2012.
6. Vincent Del Toro, “Electrical Engineering Fundamentals”, Prentice Hall of India Private Limited, 2nd Edition, 2003.
7. David Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2008.

Course Code: ESC-S101P **Breakup: 0 –0 – 3 – 2**

Course Name: Basic Electrical & Electronics Engineering Lab

Course Details:

1. Familiarization with the Electronic Instruments.
2. Familiarization with electronic components and Bread board.
3. To verify the Thevenin theorem.
4. To verify the Superposition theorem.
5. Measurement of voltage and frequency with CRO.
6. To study half wave rectifier.
7. To study full wave bridge rectifier.
8. To study full wave bridge rectifier with filter.
9. To study and verify the truth table of different logic gates using digital IC.
10. To study different type of transformer and there operation.
11. To study basic wiring and design a switchboard/extension board.
12. To study the polarity test of a single phase transformer.
13. To study the open & short circuit test of a transformer and calibration losses.
14. To study the load test and efficiency of a single phase transformer.

Course Code: MTH-S101 **Breakup: 3 – 1 – 0 – 4**

Course Name: Mathematics-I

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Test the convergence & divergence of infinite series
CO2	Understand concepts of limit, continuity and differentiability of function of two variables
CO3	Find the maxima and minima of multivariable functions
CO4	Evaluate multiple integrals, concepts of beta & gamma functions
CO5	Apply the concepts of gradient, divergence and curl to formulate engineering problems

Course Details:

Unit I

Applications of integrals : Areas between curves, Methods of finding volume : Slicing, solids of revolution , Cylindrical shell , Lengths of plane curves,Areas of Surface of revolution, Moments and Center of mass, Work, Fluid pressure and Forces .
Trapezoidal and Simpson rule , Improper integrals .

Unit II

Sequences: Definition, Monotonic sequences, Bounded sequences, Convergent and Divergent Sequences**.**
Series: Infinite series, Oscillating and Geometric series, their Convergence, Divergence . Tests of Convergence: n^{th} Term test of divergence, Integral test, Comparison Test, Limit Comparison test, Ratio test (Delambert), n^{th} root test (Cauchy root test), Alternating series, Absolute and conditional convergence..
Power Series: Power series and its convergence, Radius and interval of convergence, Term by term differentiation , Term by term integration, Product of power series, Taylor and Maclaurin series , convergence of Taylor series, Error estimates ,Taylor's Theorem with remainder .

Unit III

Vector Calculus: Vector valued functions , Arc length and Unit Tangent vector, Curvature, Torsion and TNB frame **.**
Partial Derivatives: Function of two or more variables (Limit, Continuity, Differentiability , Taylors Theorem) , Partial derivatives, Chain Rule, Partial Derivatives of higher orders, , Maxima and Minima and Saddle Point, Lagrange Multipliers, Exact differential, Jacobian, Leibnitz Theorem.
Directional derivatives, Gradient Vectors, Divergence and Curl , Tangent planes .

Unit III

Multiple Integrals: Double and triple integral, Change of order, Change of variables, Application to area and volume, Dirichlet integral and applications.
Line, surface integrals , Path independence, Statement and problems of Green's, Stoke's and

Gauss divergence theorems (without proof).

Text Books and Reference :

1. G.B.Thomas and R.L.Finney : Calculus and Analytical Geometry, Ninth Edition 2010.
2. B.S. Grewal, Engineering Mathematics, Khanna Publishers, 2004.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.

Course Code: PHY-S101T **Breakup: 3 – 1 – 0 – 3**

Course Name: Physics-I

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the behaviour of Physical bodies
CO2	Understand the basic concepts related to the motion of all the objects around us in our daily life
CO3	Gain the foundation for applications in various applied fields in science and technology
CO4	Understand the concepts of vectors, laws of motion, momentum, energy, rotational motion, central force field, gravitation, collision and special theory of relativity
CO5	Empower the students to develop the skill of organizing the theoretical knowledge and experimental observations into a coherent understanding

Course Details:

Unit-I: Newton's laws and their applications, Friction, conservative forces and potentials, Work energy theorem, conservation of energy and linear momentum, variable mass system (rocket), impulse, system of particles and collision, Elementary rigid body kinematics, rotation motion, moment of inertia, and Gyroscopic motion.

Unit-II: Rigid body motion, angular momentum, fundamental of classical mechanics, Lagrangian and Hamiltonian formulation.

Unit-III: Motion in non-inertial frames, fractious forces, special theory of relativity, central forces, Gravitation motion under central forces and Kepler's Laws.

Unit-IV: Simple harmonic motion (SHM), small oscillations and resonance; Wave particle duality, de-Broglie matter's waves, Phase and group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications.

Unit-V: Wave function and its significance, Schrödinger equations (time dependent and independent), Schrödinger's wave equation for particle in one dimensional box, diffraction of X-rays by crystal planes, Bragg's spectrometer, Compton's effect.

Text Books and References:

1. Vector Analysis by M. R. Spiegel, Schaum's Outlines, 2021
2. Introduction to Mechanics: R. D. Kleppner and J. Kolenkow, Cambridge University Press, 2nd edition, 2014
3. A textbook of Mechanics by J. C. Upadhyay,Ram Prasas Publications; 1st edition, 2017
4. Mechanics by D. S. Mathur, S. Chand; New edition, 2000
5. Theory& ProblemsofTheoretical Mechanics by M. R. Spiegel, Schaum'sOutline Series, 2017
6. Introduction to Special Theory of Relativity by Robert Resnick, Wiley, 1st edition 2007.

7. Concept of physics (Part-I) by H. C. Verma, BhartiBhawan Publisher, 2022.
8. Quantum Mechanics by L.I. Schiff, McGraw-Hill Education (India) Pvt Limited, 2017.
9. A Textbook of Quantum Mechanics by P.M. Mathews and K. Venkatesan, McGraw-Hill Education (India) Pvt Limited,2010.
10. Introduction to Quantum Mechanics by D.J.Griffiths, 3E, Cambridge UniversityPress, 2018.

Course Code: PHY-S101P **Breakup: 0 – 0 – 3 – 2**

Course Name: Physics Lab-I

Course Details:

1. Graphical Analysis (Ref. UIET Laboratory Manual)
2. Trajectory of projectile (Ref. UIET Laboratory Manual)

Apparatus Used (Trajectory Apparatus, Metal Balls, Channels, VernierCallipers, Carbon & Graph Paper)

3. Moment of Inertia of Bicycle wheel (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Bicycle Wheel, Masses, Thread, Stopwatch, Meter Scale, VernierCallipers)

4. Spring Oscillations (Ref. UIET Laboratory Manual)

Apparatus Used (Spring Oscillation Apparatus, Stop Watch, Masses)

5. Coupled Pendulum (Ref. UIET Laboratory Manual)

Apparatus Used (Coupled Pendulum Setup, Stop Watch, Scale)

6. Bifilar Suspension System (Ref. UIET Laboratory Manual)

Apparatus Used (Bifilar Suspension System Setup, Stop Watch, Masses)

7. Frequency of AC Mains by Melde's Method (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Electrical Vibrator, String, Pulley, Small Pan, Weight Box & Physical Balance)

8. Kater's(Reversible) Pendulum (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Kater's Pendulum, Stop Watch)

9. Inertia Table (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Inertia Table, Stop Watch, VernierCallipers, Split Disc, Balancing Weights, and Given Body(Disc))

Course Code: TCA – S102T **Breakup:** 1 – 1 – 0 – 2

Course Name: Workshop Technology

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	To Study on different machine tools and their operations.
CO-2	Basic knowledge of casting processes and their applications.
CO-3	Recognize the different types metal forming process and their operations.
CO-4	Introduction to basic fabrication processes such as welding
CO-5	To study on Modern trends in manufacturing, Unconventional machining Processes and Automation

Course Details:

Historical perspectives; Classification of Manufacturing process.

Machining: Basic principles of lathe machine&operations performed on it. Basic description of machines & operations of shaper-planer, drilling, milling, grinding.Unconventional machining processes , Machine tools.

Casting processes:pattern & allowances. Moulding sands & its desirable properties. Mould making with the use of a core. Gating system. Casting defects & remedies. Cupola furnace. Die-casting & its uses.

Metal forming: Basic metal forming operations & uses of such as-forging, rolling, wire& tube drawing/making & extrusion, & its products/applications, press work & die & punch assembly, cutting & forming, its application. Hot working vs Cold working. Powder metallurgy: powder metallurgy process & its applications, plastic-products manufacturing, galvanizing & electroplating.

Welding: Importance & basics concepts of welding, classification of welding processes. Gas welding, types of flames, Electric arc welding. Resistance welding. Soldering & brazing and its uses. Modern trends in manufacturing, Automation. Introduction to NC/CNC/DNC,FMS,CAD/CAM,CIM and factory of future.

Text Books and References:

1. Chapman,W A J & Arnold ,E "Workshop Technology,1972 ; vol. I,II&III" Viva Low Priced Student Edition.
2. Raghuwanshi,B S "Workshop Technology ,2015; vol. I&II" DhanpatRai& Sons
3. Chaudhary, Hajra "Elements of Workshop Technology, 2008 ; vol. I&II" Media Promoters & Publishers.

Course code: **TCA – S102P** **Breakup:** **0 – 0 – 3 – 3**

Course Name: **Workshop Practice Lab**

Course Details:

1. Foundry (1 turn)
2. Welding (3 turns)
   a. Gas Welding (1 turn)
   b. Arc Welding (2 turns)
      (i). Lap Joint (1 turn)
      (ii) Butt Joint (1 turn)
3. M/C Shop (4 Turns)
4. Fitting & Sheet Metal Work (1 turn+1 turn)
5. Carpentry Shop(1 turn)
6. Black-smithy shop(1 turn)

Text Books and References:

1.Chapman,W A J & Arnold ,E "Workshop Technology,1972 ; vol. I,II&III" Viva Low Priced Student Edition.
2.Raghuwanshi,B S "Workshop Technology ,2015; vol. I&II" DhanpatRai& Sons
3.Chaudhary, Hajra "Elements of Workshop Technology, 2008 ; vol. I&II" Media Promoters & Publishers.

Course code: **UHV – S101** **Breakup:** **0 – 0 – 0 –0**

Course Name: **Universal Human Values-I**

Course Details:

Course Code: MTH-S102 **Breakup:** 3 – 1 – 0 – 4

Course Name: Mathematics-II

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Solve the consistent system of linear equations
CO2	Determine the power series expansion of a given function
CO3	Solve arbitrary order linear differential equations with constant coefficients
CO4	Apply Laplace transforms to solve physical problems arising in engineering
CO5	Find eigen values, eigen vectors &diagonalize a matrix
CO6	Understand concept of vector space & linear transformation

Course Details:

Unit-I

Linear Algebra
Matrices, Elementary row and column operations, Echelon form, Rank of matrix, Determinants . Vector spaces, Linear dependence and Independence, Linear transforms and matrices, Consistency of linear system of equations and their solution, Special matrices : Symmetric, Hermtionetc, Characteristic equation, Cayley-Hamilton theorem(statement only), Eigen values and eigen vectors, Diagonalisation .

Unit-II

First order differential Equations : Seperable,Exact Differential Equation ,Integrating Factors, Linear differential equations with constant coefficients, Homogeneous linear differential equations, Bernouille Equation, Simultaneous linear differential equations, Differential equations of first order but not first degree, Claiurat's equation, Homogeneous linear differential equations of second order with constant coefficients, Complex root case, Differential operators, Euler-Cauchy equation Existence and uniqueness, Wronskain, Nonhomogeneous equations,
Solution by undetermined coefficients, solution by variation of parameters.
Series solution: Strum-Liouville problems , Ordinary differential equations of 2^{nd} order with variable coefficients (Frobenius Method), Orthogonal polynomials, Bessel functions .

Unit-III: Laplace Transform

Laplace transform, Existence Theorem, Laplace transform of derivatives and integrals, Inverse Laplace transform, Unit step function, Dirac Delta function, Laplace transform of periodic functions, Convolution Theorem, Applications to solve simple linear and simultaneous differential equations.

Text Books and Reference :

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
2. B.S. Grewal, Higher Engineering Mathematics, KhanPublishers,2005.

3. C. Ray Wylie & Louis C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd. 2003.
G.F. Simmons, Differential Equations, Tata McGraw-Hill Publishing Company Ltd. 1981.

Course Code: PHY-S102T **Breakup: 3 – 1 – 0 – 3**

Course Name: Physics-II

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	understand the vector integration which they can apply in electricity and magnetism
CO2	Understand the concepts of wave optics such as the phenomena of interference, diffraction and polarization of light
CO3	Understand the concepts of electrostatics, magnetostatics, electromagnetic induction, Maxwell's equations and electromagnetic waves
CO4	Apply the concepts of physics in the engineering courses

Course Details:

Unit-I: Vector analysis: scalars, vectors, vector differentiation, gradient, divergence and curl, vector, integration, Gauss divergence and Stoke's theorem, co-ordinate systems (spherical polar & cylindrical), Electrostatics: electric fields, potentials, Gauss's law, electric dipoles and multipoles, polarization, bound charges, linear dielectrics and force on dielectrics, electric displacement, boundary condition of E and D, work and energy of electrostatics, Laplace's equation and uniqueness theorem, image theory.

Unit-II: Motion of charge in electric and magnetic field, Magnetostatics: current density, magnetic fields, Ampére's law, Faraday's law, magnetic potential, magnetic polarization, bound current, magnetic properties of materials (para, dia and ferro), boundary condition of B and H, basic idea of superconductor.

Unit-III: Displacement current, Maxwell's equations for free space and matter (dielectric and conductor), Electromagnetic waves, Poynting vector.

Unit-IV: Origin the refractive index, Interference: division of wave-front and division of amplitude; diffraction: Fraunhoffer, Grating, Resolving power (grating, prism, telescope and microscope); polarization: Phenomena of double refraction, Nicol prism, optical activity Production and analysis of plane, circular and elliptical polarized light, Frenels theory of optical activities and Polarimeters.

Unit-V: Fiber optics and photonics: Fundamental ideas about optical fiber, types of fibers, Total Internal Reflection (TIR), critical angle, acceptance angle and application, basic principal of Laser and Holography and fundamental ideas about photonics.

Text Books and References

1. Optics: AjoyGhatak
2. A textbook of OPTICS: Subrahmanyam, Brijlal and Avadhanulu
3. Electrodynamics: David J. Griffith
4. Classical electrodynamics: J. D. Jackson
5. Modern Physics: Author Beiser
6. Photonic Crystals: J. D. Joannopoulos, R. D. Meade, and R. D. Winn

Course Code: PHY-S102P Breakup: 0 – 0 – 3 – 2

Course Name: Physics Lab-II

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Gain practical knowledge about electricity and magnetism and measurements such as resistance, voltage, current etc
CO2	Gain experimental knowledge of interference, diffraction and polarization of light and measurement of the wavelengths of the monochromatic light with the help of Newton's ring experiment, Fresnel's biprism experiment, etc.
CO3	Understand the concept of semiconductor physics through the four probe experiment
CO4	Gain knowledge about the various optical devices: prism, grating, spectrometer.
CO5	Understand the basic concept of modern physics through the determination of Planck's constant

Course Details:

1. Newton's Ring (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Traveling Microscope, Support for Glass Plate inclined at 45^0 to the Vertical, Short Focus Convex Lens, Sodium Lamp, Plano Convex Lens, An Optically Plane Glass Plate)

2. Prism Spectrometer (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Spectrometer, Glass Prism, Reading Lens, Mercury Lamp)

3. Plane Transmission Grating (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Spectrometer, Diffraction Grating, Mercury Lamp)

4. Ballistic Galvanometer (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Ballistic Galvanometer, Morse key, Damping key, Condenser, Rheostat, Volt Meter, Storage Battery, Connection Wires)

5. Carey Foster's Bridge (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Carey Foster's Bridge, Laclanche cell, Resistance Box, Galvanometer, Plug Key, Copper Strip)

6. Fresnel's Biprism (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Sodium Lamp, Biprism, Convex Lens, Optical Bench with Four Uprights)

7. Variation of Magnetic Field (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Stewart and Gee type Tangent Galvanometer, Storage Battery,

Commutator, Ammeter, Rheostat, One way Plug Key, Connection Wires)

8. Polarimeter (Ref. Book by K. K. Dey, B. N. Dutta)

Apparatus Used (Sodium Lamp, Polarimeter, Physical Balance)

Course Code: ISC – S101T Breakup: 3 – 0 – 0 – 3

Course Name: Programming & Computing(C & UNIX)

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Recollect various programming constructs and to develop C programs
CO2	Understand the fundamentals of C programming
CO3	Choose the right data representation formats based on the requirements of the problem
CO4	Implement different Operations on arrays, functions, pointers, structures, unions and files

Course Details:

Basic concepts of Computers, Basic UNIX Concepts and Vi – Editor
Introduction to C: Basic Programming concepts, Program structure in C, Variables and Constants, Data types, Conditional statements, control statements, Functions, Arrays, Structures, Introduction to pointers, Introduction to File Systems.

Text Books and References:

1. Programming in C, Schaum Series, 3rd edition, BPB Publication, Byron S. Gottfried
2. The 'C' Programming, Denis Ritchi, Second edition, PHI, 1988
3. Mastering C, Venugopal, Second edition, TMH, 2006
4. Let Us C, YashavantKanetkar, 18th Edition, BPB, 2021
5. Programming in ANSI C, Balaguruswami, Eighth Edition, TMH, 2019

Course Code: ISC – S101P Breakup: 0 – 0 – 3 – 2

Course Name: Computer Programming Lab:

Course Details:

Learning OS Commands
Practice of all Internal and External DOS Commands, Writing simple batch programs, Exposure to Windows environment, Practice of UNIX commands and Vi editor, Writing simple shell script

C Programming:
Practicing programs to get exposure to basic data types,algebraic expressions, Conditional statements, Input Output Formatting, Control structures, arrays, functions, structures, pointers

and basic file handling.

Course Code: TCA-S101 **Breakup: 0 –2 – 3 – 5**

Course Name: Engineering Drawing

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the basics of engineering graphics
CO2	Develop skills to prepare basic engineering drawings
CO3	Understand the concept of projection and acquire visualization skills
CO4	Gain imaginative skills to understand section of solids and developments of surfaces

Course Details:

Introduction- Drawing instruments and their uses, BIS conventions, lettering dimensioning and free hand practicing.

Orthographic projections: Lines, planes and surfaces of objects, Sectional views, Auxiliary views, Space geometry: lines and planes, True lengths and shapes, Properties of parallelism, Perpendicularity and intersections of lines and planes, Simple intersections of solids and development of lateral simple solids**.**

Isometric Projections: Introduction , isometric scale, isometric projection of simple plane figures, isometric projection of tetrahedron, hexahedron (cube), right regular prisms , pyramids, cylinders, cones, spheres, cut spheres and combinations of solids.

Introduction to computer graphics: Some problems on above topics on computer graphics.

Text Books and References:

1. Narayana,K.L. &Kannaiah,P. “Engg.Graphics”. Tata McGraw Hill, New Delhi (2012).
2. Bhatt,N.D. (2014) “Elementary Engg. Drawing” Charotar Book stall. Anand.
3. Lakshminarayanan ,V and VaishWannar , R. S. “Engg.Graphics”.Jain Brothers , New Delhi (2006).
4. Agrawal B. &Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
5. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
6. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

Course Code: HSS-S101 **Breakup: 3 –1 – 0 – 4**

Course Name: Communicative English

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Enhance their communication skills for tackling the professional challenges of a diverse workplace
CO2	Learn effective writing skills and be able to write clear technical reports
CO3	Improve their verbal and non-verbal communication
CO4	Be fluent orally in the use of the nuances of the English language
CO5	Learn good interpersonal skills and be proficient with the soft skills required for national and global placements

Course Details:

Unit 1: Basics of Technical Communication: Technical Communication: features; Distinction between General and Technical communication; Language as a tool of communication; Levels of communication: Interpersonal, Organizational, Mass communication; The flow of Communication: Downward, Upward, Lateral or Horizontal (Peer group); Barriers to Communication.

Unit 2: Constituents of Technical Written Communication: Word formation, Prefix and Suffix; Synonyms and Antonyms; Homophones; One Word Substitution; Technical Terms; Paragraph Development: Techniques and Methods -Inductive, Deductive, Spatial, Linear, Chronological etc; The Art of Condensation- various steps.

Unit 3: Forms of Technical Communication: Business Letters: Sales and Credit letters; Letter of Enquiry; Letter of Quotation, Order, Claim and Adjustment Letters; Memos, Notices, Circulars; Job application and Resumes. Reports: Types; Significance; Structure, Style & Writing of Reports. Technical Proposal; Parts; Types; Writing of Proposal; Significance.

Unit 4: Presentation Strategies: Defining Purpose; Audience & Locale; Organizing Contents; Preparing Outline; Audio-visual Aids; Nuances of Delivery; Body Language; Space; Setting Nuances of Voice Dynamics; Time- Dimension.

Unit 5: Value- Based Text Readings: Following essays form the suggested text book with emphasis on Mechanics of writing,

(i) The Language of Literature and Science by A.Huxley
(ii) Man and Nature by J.Bronowski
(iii) The Mother of the Sciences by A.J.Bahm
(iv) Humanistic and Scientific Approaches to Human Activity by Moody E. Prior
(v) The Effect of Scientific Temper on Man by Bertrand Russell.

Text Books and References:

1. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, OxfordUniv. Press, New Delhi.

2. Technical Communication – Principles and Practices by Meenakshi Raman &Sangeeta Sharma, Oxford Univ. Press 2007, New Delhi.
3. Effective Technical Communication by Barun K. Mitra, OxfordUniv. Press, 2006, New Delhi
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., New Delhi.
5. How to Build Better Vocabulary by M.Rosen Blum, Bloomsbury Pub. London.
6. Word Power Made Easy by Norman Lewis, W.R.Goyal Pub. & Distributors; Delhi.
7. Developing Communication Skills by Krishna Mohan, MeeraBanerji- Macmillan India Ltd. Delhi.
8. Manual of Practical Communication by L.U.B. Pandey& R.P. Singh; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, Delhi.

Detailed Syllabus
2nd Year

Course Code: MTH-S201 **Breakup: 3 – 1 – 0 – 4**

Course Name: Mathematics - III

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Obtain the Fourier series expansion of a given function
CO2	Apply Fourier transform for solving Boundary Value Problems
CO3	Determine the solution of linear partial differential equations (PDE) by variable Lagrange's method & some nonlinear PDEs
CO4	Understand and use of complex variable & analyticity
CO5	Expand a function of Laurent series
CO6	Evaluation of real integrals using residues

Course Details:

Unit – I : Function of a Complex variable

Complex numbers- power and roots, limits, continuity and derivative of functions of complex variable, Analytic functions, Cauchy-Reimann equations, Harmonic function, Harmonic conjugate of analytic function and methods of finding it, Complex Exponential, Trigonometric, Hyperbolic and Logarithm function.

Unit – II : Complex Integration

Line integral in complex plane(definite and indefinite), Cauchy's Integral theorem, Cauchy's Integral formula, Derivatives of analytic functions, Cauchy's Inequality, Liouville's theorem, Morera's theorem, Power series representation of analytic function and radius of convergence,Taylor's and Laurent's series, singularities, Residue theorem, Evaluation of real integrals, Improper Integrals of rational functions, Fourier integrals.

Unit – III : Fourier Series

Periodic functions, Trignometric series, Fourier series of period 2π , Eulers formulae, Functions having arbitrary period, Change of interval, Even and odd functions, Half range sine and cosine series, Complex fourier series, Fourier Integrals, Fourier Sine and Cosine Transform.

Unit – IV : Partial Differential Equations

Solution of first order partial differential equations-Linear and nonlinear(Charpit's method), Linear partial differential equations with constant coefficients of second order and their classifications - parabolic, elliptic and hyperbolic with illustrative examples. Methods of finding solutions using seperation of variables method. Wave and Heat equations upto two dimension

Unit – V : Probability and Statistics

Basics of probability, Bayes theorem, Random variables, Probability and density fuctions, Binomial, Poisson and Normal distributions.

Text Books and Reference :

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
2. B.S. Grewal, Higher Engineering Mathematics, KhanPublishers, 2005.

Course Code: ESC-S201 **Breakup: 3 – 1 – 0 – 4**

Course Name: Engineering Mechanics

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	Determine the resultant force and moment for a given system of forces
CO-2	Determine the Centre of Gravity and Moment of Inertia of surfaces and solids
CO-3	Determine the shear force, Bending moment of beams and analyze the trusses and problems related to frictions
CO-4	Determine the stresses in beam for pure bending and effect of torsion in shafts
CO-5	Calculate the motion characteristics of a body subjected to a given force system

Course Details:

General Coplanar force systems : Basis concepts, Law of motions, principle of transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, simplest resultant of two dimensional concurrent & non concurrent force systems, free body diagrams, equilibrium & its equations, applications.

Trusses & Cables : Introductions, simple truss & solutions of simple truss, method of joints & method of sections.

Friction: Introductin , Laws of coulomb friction, equilibrium of bodies involving dry friction, belt friction, applications.

Centre of gravity , centroid, Moment of Inertia : Centroid of plane, curve, area ,volume & composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principal moment inertia, mass moment of inertia of circular ring, disc, cylinder, sphere and cone about their axis of symmetry.

Beams: Introductions, shear force and bending moment, differential equations for equilibrium, shear force & bending moments diagrams for statically determinate beams.
Kinematics of rigid body: Introduction, plane motion of rigid bodies, velocity & acceleration under translation & rotational motion, Relative velocity, projectile motion.

Kinetics of rigid bodies: Introduction, force, mass & acceleration, work & energy, impulse & momentum, D'Alembert principles & dynamic equilibrium. Virtual work.

Text Books and Reference :

1. Beer F.P. & Johnston ,F.R. " Mechanics For Engineers" 11th edition 2017, McGraw Hill.
2. Shames, I.H. " Engg. Mechanics" 4th edition2005 , P H I.
3. Meriam , J. L. " Statics" 7th edition 2011, J. Wiley.
4. Meriam , J. L. " Dynamics" 7th edition 2011, J. Wiley.

Course Code: ESC-S202 **Breakup: 3 – 1 – 0 – 4**

Course Name: Thermodynamics

Course Outcomes (CO): At the end of the course, the student will be able to:

CO-1	Analyze the types of thermodynamic systems, heat and work interactions
CO-2	Apply knowledge of laws of thermodynamic to practical systems
CO-3	Understand the concept of energy, entropy and equilibrium
CO-4	Able to calculate the efficiency of systems, cycles
CO-5	Understand the concept of different cycles needed for power, refrigeration

Course Details:

Fundamental concepts: System , Property, Work and Heat interactions.
Zeroth law: Zeroth law of thermodynamics, Temperatutre& its measurement & scales.
First law: Thermodynamic processes, calculation of work in various processes, non flow work & flow work. Joule's experiment, First law of thermodynamics applied to open systems, study flow system and their analysis. Applications to closed systems and flow processes. Analysis of unsteady processes. Limitations of first law of thermodynamics, PMM1.Thermodynamics properties of fluids.
Second law: Devices coverting heat to work, Thermal reservoir, heat engines efficiency, Devices converting work to heat, heat pump, refrigerator, COP, Reversed heat engine, Kelvin planck statements, Clausiusstatement,reversible& irreversible processes, Carnot cycle ,PMM2, Entropy , Availability , equilibrium Criterion , Maxwell Relations Thermodynamics relations , Clapeyron equation , Gibb's Phase rule. **Properties of steam & thermodynamic cycles:** pure substance, properties of steam, Phase Diagram, Power & Refrigeration cycles ,Psychrometry. Adiabatic flame temperature , Equilibrium conversion, Statistical definition of entropy Kinetic theory of Ideal Gases.

Text Books & References:

1. Yunus A. Cengel , Michael A. Boles , 2014, 8th Edition, Thermodynamics: An Engineering Approach, McGraw-Hill Education.
2. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.
Reference Books:
1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

Course Code: MEE-S201T **Breakup: 2 – 0 – 0 – 3**

Course Name: Mechanical Design & Drawing

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	The Fundamentals of engineering drawing and represent various pictorial views to Orthographic views.
CO-2	Gain knowledge Working drawings Machine elements
CO-3	Gain knowledge on Keys and cotter joints Riveted joints Couplings
CO-4	Assembly drawings-Engine parts : Stuffing box Assembly drawings : Connecting rod and eccentric
CO-5	Assembly drawings: Screw Assembly drawings: Machine vice and tailstock Assembly drawings Rams-bottom Safety Valve, feed check valve

Course Details:

Review of engineering graphics, IS&ISO codes, Free hand sketching of Part Drawing & Dimensioning. Fits & Tolerances, Surface Finish , Design Of Simple machine elements;(Threaded fasteners, locking arrangements , Guides) of some assemblies. Design of joints; riveted ,welded & cotter. Design of keys. Shaft and Couplings Assembly drawing & part list . Computer aided drafting of machine components. Valves etc. A drawing Project on reverse engineering.

Text Books and References :

1. Lakshminarayanan ,v. &Mathur ,M.L., 2016 ," A Text Book of Machine Drawing". Jain Brothers, N. Delhi.
2. Siddheswar ,N. ,Kannaiah, P.&Sastry V.V.S. " Machine Drawing", 2017; TMH,N.Delhi.
3. Bhandari, V.B. "Design of Machine Elements, 4th edition 2017; TMH.N.Delhi.
4. Shigley&Mische,"Mechanical Engg. Design", 2002; McGraw Hill.

Course Code: MEE-S201T **Breakup: 0 – 0 – 3 – 2**

Course Name: Mechanical Design & Drawing Lab

Course Details:

1 Drawing sheet (1 sheet)-Introduction:Scales, Type of lines, section line, dimensioning.
2 Drawing sheet-(1 sheet)-Orthographic projection in first & third angle of machine elements
3 Drawing sheet-(2 sheet)- Screwed fasteners
4 Drawing sheet-(1 sheet)- Keys & cotters and pin joints

5 Drawing sheet-(1 sheet)- Shaft couplings
6 Drawing sheet-(1 sheet)- Riveted joints
7 Drawing sheet-(3 sheet)- Assembly drawing

Text Books and References :

5. Lakshminarayanan ,v. &Mathur ,M.L., 2016 ," A Text Book of Machine Drawing". Jain Brothers, N. Delhi.
6. Siddheswar ,N. ,Kannaiah, P.&Sastry V.V.S. " Machine Drawing", 2017; TMH,N.Delhi.
7. Bhandari, V.B. "Design of Machine Elements, 4th edition 2017; TMH.N.Delhi.
8. Shigley&Mische,"Mechanical Engg. Design", 2002; McGraw Hill.

Course Code: MEE-S202 Breakup: 3 – 1 – 3 –5

Course Name: Basic Fluid Mechanics and Rate Processes

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	Understanding to State the Newton's law of viscosity and Explainthe mechanics of fluids at rest and in motion by observing the fluid phenomena
CO-2	Understanding to State the Newton's law of viscosity and Explainthe mechanics of fluids at rest and in motion by observing the fluid phenomena
CO-3	Applying to Derive Euler's Equation of motion and Deduce Bernoulli's equation.
CO-4	Applying and Analyzing to Compute force of buoyancy on a partially or fully submerged body and Analyzethe Examine energy losses in pipe transitions and sketch energy gradient lines.
CO-5	Understanding the basics of rate equations under steady and unsteady heat and mass transfer

Course Details:

FLUID MECHANICS:
Fluid statics, Description of flows, Conservation of mass ; Stream function , momentum theorems , Navier – Stokes equation ,energy equation , Similitude &modelling. High Reapproximation, Boundary layers.

HEAT & MASS TRANSFER:
Rate law & Conservation law. Steady State & Unsteady conduction, Elementary convection . Simple ideas of mass transfer.

Text Book and References:

1. Agarwal , " Fluid Mechanics & Machinery" , TMH, 2010.
2. Som , S.K. &Biswas,G. " Introduction to Fluid Mechanics &Machins "TMH, 2012.
3. Bansal R.K. "A Text Book Of Fluid Mechanics & Hydraulic Machines" Laxmi Publications (p) Ltd. 2019.
4. Fluid Mechanics & Turbo Machines – M.M.Das, PHI, 2010.

Course Code: MEE-S202P
Course Name: Basic Fluid Mechanics and rate processes lab
Type: L T P Credits
Breakup: 0– 0 – 3 – 2

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following:

1. To verify the momentum equation using the experimental set-up on impact of jet.
2. To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
3. To calibrate an orifice meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To calibrate a Venturimeter and study the variation of the co-efficient of discharge with the Reynolds number.
5. To calibrate a bend meter and study the variation of the co-efficient of discharge with the Reynolds number. .
6. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
7. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
8. To study the variation of friction factor, _f` for turbulent flow in commercial pipes.
9. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
10. To determine Meta-centric height of a given ship model.
11. To determine the head loss for a sudden enlargement
12. To determine the head loss for a sudden Contraction

Course Code: EVS-S101 **Breakup: 2 –0 – 0 – 2**
Course Name: Environmental Science

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the concepts and definitions associated with ecosystems, environmental pollution and its causes
CO2	Gain knowledge to analyse problems and suggest alternatives and new methods to manage natural resources
CO3	Understand how to Redesign, Recreate & Restore the ecosystems
CO4	Understand the legal aspects and the role of government in environment protection

Course Details:

UNIT-I
Scope and Importance of environmental studies, Need for public awareness, Segments of environment, biodiversities: Genetic diversity, Species diversity, Ecosystem diversity, Landscape diversity, Causes of pollution and detrimental effects.

UNIT-II
Eco systems- Types of systems, energy flow in an ecosystem, Balanced ecosystem,
Human activities- Food, shelter, economic and social security, Effects of human activities on environment- Agriculture, housing, Industry, mining and transportation activities, Basics of Environmental Impact Assessment, Sustainable Development.

UNIT-III
Types of natural resources: Water resources-Availability and quality aspects, Water borne diseases, Fluoride problems in portable water, Mineral resources, Food resources, Land resources, Forest Wealth, Material cycles- Carbon, Nitrogen and Sulphur cycle.

UNIT-IV
Energy- Different types of energy (Renewable and Non-renewable), Convectional and non-conventional energy-sources Electromagnetic radiation, Hydro Electric, Fossil fuel based, Nuclear, Solar, Biomass and Bio-gas, Hydrogen as an alternative future source of energy

UNIT-V
Environmental pollution and their effects, Water pollution, Land pollution, Noise pollution, public Health aspects, Air pollution. Current environmental issues of importance and their impact on environment: Population Growth, Climate change and global warming effect, Urbanization, Automobile pollution, Acid rain, Ozone layer depletion.

UNIT-VI
Preventive measures and control of pollution, Air and Water pollution control, Solid waste management, Case studies.

UNIT-VII
Role of Government in environment protection, Legal Aspects, Initiatives and protection Acts, public awareness, Initiatives by Non-governmental Organizations (NGOs), Role of IT services, Disaster management.

UNIT-VIII
Field work/ Activities/ Visit

Text and References Books:

1. Environmental Studies- Benny Joseph, TATA Mcgaw Hill publication.
2. Environmental Studies- Dr. D.L. Manjunath, pearson Education.
3. Environmental Studies- R. Rajgopalan, Oxford publication.
4. Environmental Science and Technology- M. Anji Reddy, BS publication.
5. Principles of Environmental Science and Engineering- P. VenugopalanRao, Prentice Hall of India.
6. Environmental Science and Engineering- Meenakshi, Prentice Hall of India.

Course Code: **MEE-S203T** **Breakup:** **3 – 1 – 0 –3**

Course Name: **Kinematics and Mechanisms**

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	Identify link, pair, chain, joints and inversions of mechanisms.
CO-2	Construct the velocity and acceleration diagrams for different mechanisms
CO-3	Understand Cam profile generation and their applications
CO-4	Learn the concept of gear and gear train and various automotive transmissions.
CO-5	Understand balancing of different machines

Course Details:

Introduction: Links-Types,Kinematic Pairs-Classification, constraints-types, Degree of freedom of planar mechanism. Inversions of four bar chain, slider crank chain and double slider crank chain. Mechanism Diagram & inversion. Mobility & Range of Movements.

Displacement, Velocity & Acceleration analysis of planar linkages.

Dimensional synthesis for motion ,Function & path generation.

Dynamic force analysis, Cam profile Synthsis, flywheel, Inertia forces & Balancing for Rotating & Reciprocating Machines.

Text Book and References:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East West Pvt. Ltd, New Delhi, 1988.

Course Code: **MEE-S203P** **Breakup:** **0 – 0 – 3 –2**

Course Name: **Kinematics and Mechanisms Lab**

Course Details:

1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage

3. Study of inversions of single/double slider crank mechanisms
4. Study of paucellier mechanism
5. Study of Hart Mechanism
6. Study of Grass-Hopper Mechaism
7. Study of Watt Mechanism
8. Study of Tchebicheff Mechanism

Course Code: MEE-S204 **Breakup: 3 – 1 – 0 – 4**

Course Name: Basic Solid Mechanics

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	Analyze the behavior of the solid bodies subjected to various types of loading
CO-2	Apply knowledge of materials and structural elements to the analysis of simple structures
CO-3	Compute the slope & deflection, bending stresses and shear stresses on a beam.
CO-4	Calculate torsional shear stress in shaft and buckling on the column
CO-5	Apply the concept of principal stresses and theories of failure to determine stresses on a 2-D element.
CO-6	Utilize the concepts of SFD & BMD, torsion and principal stresses to solve combined loading application based problems.

Course Details:

Introduction: Stresses & strains, elastic constants,
Compound Stress & Strains: Introduction, State of plane stress, principal stress and strain, Mohr's circle, Modelling of supports & equilibrium of forces / moments, Principles of mechanics , Axially loaded members & pressure vessels , Force analysis of slender members (BMD & SFD) . Stress at a point . Mohr circle , Strain at a point . 1-D material behaviour , Equationsm of elasticity, Torsion of shafts & tubes .
Bending of beams with symmetric cross – section , Combined stresses, Yield criterion. Deflections in bending .
Deflection of indeterminate systems by energy methods Concept of elastic instability.
Thin cylinder & spheres, Thick Cyllinder,
Helical & leaf spring,
columns & struts.

Text Books and Reference :

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.

Course Code: MEE-S205T Breakup: 3 – 0 – 0 –3

Course Name: Material Science and Engineering

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	Know the structure crystalline solid, crystal imperfections and defects
CO-2	Understand the phase diagrams and comprehend the phase transformations in of materials
CO-3	Understand the process of heat treatment
CO-4	Understand the electrical, magnetic and optical properties of important materials
CO-5	Appreciate the properties of rubber, plastic, ceramic and other important materials for different engineering applications

Course Details:

Structuring of crystelline solids , liquids and glass, imperfectionsin crystals , multiphase structures , phase change , mechanical behaviour , tensile properties , plastic properties , creep , fracture electric and magnetic properties , magnetic materials for applications , heat treatment process , effect of alloying elements on the properties of cabon steel , general properties, composition and uses of alloys of alluminium copper , nickel and bearing materials ., Chemical properties—Corrosion and oxidation , cutting tool and die materials , spring alloys , introduction to rubber , plastic , ceramic and refractory materials , Smart materials

Text Book and References:

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

Course Code: MEE-S205P Breakup: 0 – 0 – 3 –2

Course Name: Materials and Mechanical Metallurgy Lab

Course Details:

1. Strength testing of a given mild-steel specimen on UTM.
2. Impact testing on impact testing machine like Charpy, Izod.
3. Hardness testing of a given specimen using Rockwell &Vicker's/Brinell testing.

4. Fatigue testing on fatigue testing machine.
5. Creep testing on creep testing machine
6. Deflection of beam experiment
7. Torsion testing of a rod on torsion testing machine
8. To determine the compression test and determine the ultimate compressive strength for a specimen

Course Code: **MEE-S206T** **Breakup:** **3 – 0 – 0 –3**

Course Name: **Material removal manufacturing Process**

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	Understand the concept of state of stress, strain, and significance of compatibility conditions.
CO-2	Understand The concept of energy methods for solving problems.
CO-3	Understand the theory of bending of curved bars for solving problems.
CO-4	Learn the underlying theory of unsymmetrical bending and concept of shear centre

Course Details:

Unit I

Metal Cutting: Mechanics of metal cutting. Geometry of tool and nomenclature.ASA system orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required for turning, milling and drilling. Cutting fluids/lubricants.Tool materials. Tool wear and tool life. Machinability. Force measurement. Economics of metal cutting.

Grinding &Super finishing

(i) Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and grinding criteria. Surface and Cylindrical grinding. Centerless grinding. (ii) Super finishing: Honing, lapping, polishing.

Unit II

Machine Tools: (i) Lathe: Principle, construction, types, operations, Turret / capstan, semi / Automatic, Tool layout ; (ii) Shaper, slotter, planer : Construction, operations & drives; (iii) Milling : Construction, Milling cutters, up & down milling. Dividing head & indexing. Various types of milling cutters; (iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills.

Unit III

Limitations of conventional manufacturing process and need of unconventional manufacturing processes. Mechanical processes such as Ultrasonic machining, Abrasive Jet Machining: Principle, Application, Advantages and disadvantages, Variables in AJM, Water Jet Machining- Jet Cutting equipment, Principle, advantages, Practical Application;

Unit IV

Electro Discharge Machining: mechanism of material removal ,EDM circuitry and principles of operation, Analysis of relaxation circuits, Concepts of critical resistance, Machining accuracy and surface finish, Tool Material, Dielectric fluid, Application

limitation, Laser Beam Machining: Lasing process and principle, population inversion, Principle of Ruby laser, Nd: YAG Laser and CO2 Laser, Power control of laser output, Application and Electron Beam Machining: Basic principle, Controlling parameters and focal distance, Application. Plasma Arc Machining: generation of Plasma, Equipments

Text & Reference Books :

1. Modern machining processes,2017, P.C.Pandey and H.S.Shan; McGraw hill.
2. Nontraditional Manufacturing Processes", 2019, G.F.Benedict, CRC Press.
3. Nontraditional and Hybrid Machining Processes, 2005, H. Abdel and G. El-Hofy; McGraw-Hill Professional.

Course Code: MEE-S 206 P
Course Name: Material removal manufacturing Process Lab

Type:	**L**	**T**	**P**	**Credits**
Breakup:	**0–**	**0 –**	**3**	**– 2**

Any 8 experiments out of the following:

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe Machine.
2. Taper turning operation on lathe.
3. Bolt (thread) making on Lathe machine.
4. Tool grinding (to provide tool angles) on tool- grinder machine.
5. Gear cutting on Milling machine.
6. Machining a block on shaper machine.
7. Finishing of a surface on surface- grinding machine.
8. Drilling holes on drilling machine and study of twist-drill.
9. Study of different types of tools and its angles & materials.
10. Experiment on tool wear and tool life.
11. Gas welding of a lap joint.
12. Arc welding of a lap/butt joint.
13. Resistance spot welding of two thin metallic sheets.
14. Experiment on Electro discharge machining.

Course Code: HSS-S201 Breakup: 3 – 0 – 0 –4

Course Name: Industrial Management

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the concepts related to business and demonstrate the roles, skills and functions of management
CO2	Understand how the industrial company can be organized and managed
CO3	Understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities
CO4	Express leadership and entrepreneurial attributes through various case studies

Course Details:

Introduction to Industrial management, Brief history of industries in India, Brief definition of management, organization and administration. Characteristics of management, Principle of management, Function of management like, planning, organization, direction, co-ordination etc.

Level of management, skills of management, inter relation between skills and levels of management, scientific management, Introduction to Schools of Management thoughts, introduction to organization, study of basic type of organization for ex. Line and staff organization, project organization, metrics organization, Informal organization, Introduction to industrial Psychology, Motivation theory and study of Maxlow, Need, Hierarchy Theory, Planned Location, Planned Layout. Study of different forms of layout like line layout, process layout, product layout, combinational layout, sixth position layout etc.

Objective of planned layout, introduction to material management, scope of material management, study of inventory control method, introduction to different types of inventory control techniques, introduction to work study, motion study etc, introduction to conflictmanagement.

Text Book and References:

1. Industrial Engineering , 2007, Khanna O.P; DhanpatRai& Co.
2. Industrial Engineering and Management, 2017, S. C. Shrma and T.R. Banga; Khanna Book Publishing Co. (P) Ltd.
3. Industrial Management, 2018, M. Mahajan; DhanpatRai& Co.

Course code: UHV – S201 Breakup: 2 – 1 – 0 –3

Course Name: Universal Human Values-II

Courseoutcomes(CO): Attheendofthecourse,thestudentwillbeableto:

CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc
CO3	Understand the role of a human being in ensuring harmony in society and nature
CO4	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work

CourseDetails:

UNIT I: Introduction to Value Education
Value Education, Definition, Concept and Need for Value Education.
The Content and Process of Value Education
Basic Guidelines for Value Education
Self exploration as a means of Value Education
Happiness and Prosperity as parts of Value Education

UNIT II: Harmony in the Human Being
Human Being is more than just the Body
Harmony of the Self ('I') with the Body
Understanding Myself as Co-existence of the Self and the Body
Understanding Needs of the Self and the needs of the Body
Understanding the activities in the Self and the activities in the Body

UNIT III: Harmony in the Family and Society and Harmony in the Nature
Family as a basic unit of Human Interaction and Values in Relationships
The Basics for Respect and today's Crisis: Affection, e, Guidance, Reverence, Glory, Gratitude and Love
Comprehensive Human Goal: The Five Dimensions of Human Endeavour.
Harmony in Nature: The Four Orders in Nature.
The Holistic Perception of Harmony in Existence

UNIT IV: Social Ethics
The Basics for Ethical Human Conduct
Defects in Ethical Human Conduct
Holistic Alternative and Universal Order
Universal Human Order and Ethical Conduct
Human Rights violation and Social Disparities

UNIT V: Professional Ethics
Value based Life and Profession.
Professional Ethics and Right Understanding
Competence in Professional Ethics
Issues in Professional Ethics – The Current Scenario
Vision for Holistic Technologies, Production System and Management Models

TextandReferenceBooks:

1. R.R. Gaur., R, Sangal. G.P Bagaria., A Foundation Course in Value Education, Excel Books, (2009).
2. R.R. Gaur., R, Sangal. G.P Bagaria, Teachers Manual for A Foundation Course in Human Values and

Professional Ethics Excel Books, (2009).
3. A.N. Tripathy, Human Values, New Age International Publishers, (2003)
4. A. Nagaraj, JeevanVidya: EkParichaya, JeevanVidyaPrakashan, Amarkantak, (1999)
5. M.K. Gandhi, My Experiemnts with Truth, Maple Classics (2011)
6. I.C. Sharma, Ethical Philosophy of India, Nagin& Co Julundhar
7. Cecile Andrews, – Slow is Beautiful (2006)

Detailed Syllabus
3rd Year

Course Code: MEE-S301T **Breakup:** 3 – 0 – 0 – 4

Course Name: Dynamics of Machines and Vibrations

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	Identify the problems associated with unbalance in machines.
CO-2	Realize the requirement of frictional devices
CO-3	Identify the type of governors most suited for various applications.
CO-4	Understand the challenges posed by vibration

Course Details:

UNIT-I

Static & Dynamic Force Analysis

Static equilibrium of two/three force members, Static equilibrium of member with two forces and torque, Static force analysis of linkages, D'Alembert's principle, Equivalent offset inertia force, Dynamic force analysis of four link mechanism and slider crank mechanism, Dynamically equivalent system

Turning Moment & Flywheel

Engine force analysis-Piston and crank effort, Turning moment on crankshaft, Turning moment diagrams-single cylinder double acting steam engine, four stroke IC engine and multi-cylinder steam engine, Fluctuation of energy, Flywheel and its design

UNIT-II

Governors

Terminology, Centrifugal governors-Watt governor, Dead weight governors-Porter &Proell governor, Spring controlled governor-Hartnell governor, Sensitivity, Stability, Hunting, Isochronism, Effort and Power of governor

Gyroscopic Motion

Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aero planes & automobiles

UNIT-III

Balancing of Machines

Static and dynamic balancing, Balancing of several masses rotating in the same plane and different planes, Balancing of primary and secondary forces in reciprocating engine, Partial balancing of two cylinder locomotives, Variation of tractive force, swaying couple, hammer blow, Balancing of two cylinder in-line engines

Mechanical Vibrations

Types of vibrations, Elements of vibrating system, Classification, Degrees of freedom, Single degree free & force with and without damped vibrations of spring-mass system, Logarithmic decrement, Torsional vibration, Forced vibration of single degree system

under harmonic excitation, Critical speeds of shaft, two degree of freedom systems, multi degree of freedom systems, calculation of natural frequencies by Rayleigh, stodala, matrix, matrix iteration and holjder methods. Continuous system, vibrating string, string, longitudnal vibration of rods, torsional vibration of rods, Euler equation of beams.

UNIT-IV

Friction

Laws of friction, Efficiency on inclined plane, Screw friction, Screw jack, Efficiency, Friction in journal bearing-friction circle, Pivots and collar friction-Flat and conical pivot bearing, Flat collar bearing

Clutches, Bakes & Dynamometers

Single and multiple disc friction clutches, Cone clutch, Brakes-types, Single and double shoe brake, Simple and differential Band brake, Band and Block brake, Absorption and transmission dynamometers, Prony brake and rope brake dynamometers

Text Books and Reference:

1. Theory of Machines, 3rd edition 2009, Thomas Bevan; CBS Publication.
2. Theory of Machines and Mechanisms, 3rd edition 2017, Shigley; Oxford University Press-New Delhi.
3. Theory of Machines and Mechanisms, 2nd edition 1988, Ghosh&Mallik; East West Press.
4. Mechanism and Machine Theory, 2nd edition 2007, J. S. Rao&Dukkipati; New Age International Publication.
5. Theory of Machines, 4th edition 2017, S.S. Rattan; McGraw Hill.
6. Theory of Machines – R.K. Bansal (Laxmi)
7. Schaum's Outlines Series of "MechanicalVibration", 1996, S. Kelly; McGraw Hill

Course Code: **MEE-S301**P

Course Name: **Dynamics of Machine and Vibration** Lab

Type:	**L**	**T**	**P**	**Credits**
Breakup:	**0–**	**0 –**	**3**	**– 2**

EXPERIMENTS-

Minimum Eight experiments are to be conducted from the following

1. Experiments on simple and dead weight governor
2. Experiment on spring controlled governor
3. Experiment on gyroscope
4. Experiment on critical speed of shaft
5. Experiment on longitudinal vibration
6. Experiment on transverse vibration
7. Experiment on static/dynamic balancing

8. Experiment on Gear trains
9. Experiment on Gears tooth profile, interference etc.
10. Study of simple linkage models/mechanisms
11. Study of inversions of four bar linkage
12. Study of inversions of single/double slider crank mechanisms
13. Experiment on Brake
14. Experiment on clutches/dynamometers

Course Code:MEE-S302
Course Name:Material additive manufacturing Process
Breakup: 3 – 0 – 0 – 4

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	Demonstrate appropriate level of understanding on principles of additive manufacturing processes
CO-2	Choose appropriate materials for additive manufacturing processes
CO-3	Apply suitable CAD tools and CAD interface for additive manufacturing process
CO-4	Develop physical prototypes by identifying suitable process with optimum process parameters

Course Details:

UNIT I 10

Introduction of additive materials History and Advantages of Additive Manufacturing, Distinction Between Additive Manufacturing
and CNC Machining, Types of Additive Manufacturing Technologies, Nomenclature of AM Machines, Direct and Indirect Processes; Prototyping, Manufacturing and Tooling.

Layer Manufacturing Processes: Polymerization, Sintering and Melting, Extrusion, Powder Binder Bonding, Layer Laminate Manufacturing, Other Processes; Aerosol printing and Bio plotter.

UNIT II 11

Development of Additive Manufacturing TechnologyComputer Aided Design Technology, Other Associated Technology, Metal and Hybrid Systems.Generalized Additive Manufacturing Process Chain; The Eight Steps in Additive Manufacturing, Variation from one AM Machine to Another, Metal System, Maintenance of Equipment, Material Handling Issue, Design of AM.

UNIT III 11

Additive Manufacturing ProcessesVat Photo polymerization; Materials, Reaction Rates, Photo polymerization Process Modelling, Scan PatternsPowder Bed Fusion Processes; Material, Powder Fusion Mechanism, Process Parameters and Modeling, powder HandlingExtrusion Based System; Basic principles, plotting and Path Control, Other SystemsMaterial Jetting; Materials, Material Processing Fundamentals, Material Jetting MachinesDirected Energy Deposition Processes; General DED Process Description, Material Delivery, DED systems, Process Parameters, Processing-Structure-Properties Relationships

UNIT IV 8

Casting: Basic principle & survey of casting processes. Types of patterns and allowances.Types and properties of moulding sand.Elements of mould and design considerations, Gating, Riser, Runners, Core.Solidification of casting, Sand casting, defects & remedies and inspection.Cupola furnace. Die Casting, Centrifugal casting. Investment casting, CO_2 casting and Stir casting etc.

Survey of welding and allied processes.Gas welding and cutting, process and equipment. Arc welding : Power sources and consumables. TIG & MIG processes and their parameters.Resistance welding - spot, seam, projection etc.Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Shrinkage/residual stress in welds.Distortions& Defects in welds and remedies. Weld decay in HAZ. Joining of non metallic components, Introduction to unconventional welding.

Books and References:

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 2nd edition 2015, Ian Gibson , DSavid W. Rosen , Brent Stucker, Springer.
2. Understanding Additive Manufacturing, 2012, Andreas Gebhardt, Hanser. Science Direct.
3. Additive Manufacturing, 2016, AmitBandyopadhyay, Susmita Bose, CRC Press.
4. Rapid Prototyping: Principles and Applications, 3rd edition 2010, Chee Kai Chua, Kah Fai Leong, Chu Sing Lim; World Scientific Publishing Co. Pvt. Ltd.

Course Code: MEE-S303 **Breakup:** 3 – 0 – 0 – 3

Course Name: I C Engines

Course outcome (CO): At the end of the course, the student will be able to:

CO-1	Understand the basic component and working cycle of the IC engine
CO-2	Understand the parameters that affect engine performance, combustion, knock.
CO-3	Apply thermodynamics cycles for steam power plant
CO-4	Evaluate the performance of boiler
CO-5	Know the components which improve the performance of boiler and steam turbines
CO-6	Understand functions of the components of nuclear power plant.

Course Details:

Unit-1 **11**

Introduction to I.C Engines: Engine classification, Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto and Diesel cycle , Sterling cycle, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram

Fuels: Fuels for SI and CI engine, important qualities of SI and CI engine fuels, Rating of SI engine
and CI engine fuels, Biodiesel, Gaseous fuels, LPG, CNG, Biogas , Alternative fuels for IC engines

Unit–2 **10**

SI Engines: Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion , combustion chamber design, Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI. Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition

Unit–3 **9**

CI Engine: Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber
design of CI engines; Fuel injection in CI engines, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings; Scavenging in 2 Stroke engines

Unit-4 **10**

Engine Cooling: Different cooling systems, Radiators and cooling fans.
Lubrication: Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.
Supercharging: Effect of altitude on power output, Types of supercharging
Testing and Performance: Basic measurements, Optical measurement techniques, Laser Doppler anemometry, Testing of SI and CI engines.

Text Books and References:

1. IC Engine, 4th edition 2017, V. Ganesan; TMH
2. IC Engine, 2nd edition 2000, C. R. Ferguson; J Willey and sons
3. ICEngine, 2018, M. L. Mathur and R. P. Sharma; DhanpatRai Publications
4. Gill, Smith, Ziurs - Fundamentals of Internal Combustion Engine , 4th edition 2007; Oxford & IBH Publishing Co.
5. Internal Combustion Engine Fundamental, 1988, J. B. Heywood; McGraw hill

Course Code: MEE- S303 P
Course Name: I C Engine LabBreakup: 0 – 0 – 3 –2

Course Details:

Any 8 experiments out of following:

1. Performance analysis of Four stroke S.I. Engine
2. Determination of Indicated H.P. of I.C. Engine by Morse Test
3. Performance analysis of Four stroke C.I. Engines
4. Study & experiment on valve mechanism
5. Experiment on Exhaust gas analysis of an I.C. Engine
6. Study & experiment on differential gear mechanism of rear axle
7. Study & experiment on Steering mechanism
8. Study & experiment on Automobile Braking System
9. Study & experiment on Chassis and suspension system
10. Study & experiment on Ignition system of I.C. Engine
11. Study & experiment on Fuel supply system of S.I. Engine
12. Study & experiment on Fuel supply system of C.I. Engine

Course Code: **MEE-S304** **Breakup:** **3– 0 – 0 – 4**

Course Name: **Energy System**

Course outcome (CO): At the end of the course, the student will be able to:

CO-1	Apply thermodynamics cycles for steam power plant
CO-2	Apply thermodynamics cycles for steam engine
CO-3	Evaluate the performance of steam turbines
CO-4	Apply thermodynamics cycles for gas power plant and Evaluate the performance of gas turbines
CO-5	Understand functions of the components of nuclear power plant.

Course Details:

Unit-I

Steam power plant: Rankine cycle,General layout of steam power plant, Power plant boilers. Types of boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system,
Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds

Unit –II

Steam Turbines and Steam engine

Working & classification of Steam engine, Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

Unit –III

Gas turbine power plant: *Brayton cycle* Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant

Unit –IV

Nuclear power plant: Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection ofnuclear power plants.

Text Books and References:

1. Thermodynamics and Energy Systems Analysis, 2012, Borel and Favrat; CRC Press.
2. Gas turbine Theory & Practice, 1996, Cohen & Rogers; Addison Wesley Long man.
3. Basic and Applied Thermodynamics, 2nd edition 2017, P.K. Nag; McGraw hill.
4. Power Plant Engineering, 4th edition 2017, P K Nag; McGraw hill.
5. Applied Thermodynamics for Engineering Technologists, 5th edition 1993; Eastop&Mcconkey.

Course Code: **SST-S201** **Breakup:** **0 – 0 – 2 – 2**

Course Name: **Summer Training/ Mini Project**

Course Details:

6-8 Weeks practical training in a reputed industry/organization is to be undertaken during summer after completing six semestersof study. The student will submit detailed report and givepresentation on training.

Course Code: **SSM-301** **Breakup:** **0 –0 – 2 –2**

Course Name: **Seminar**

Course Details:

Emphasis on to develop the skill in presentation and group discussion. The subject may be selected from engineering/management.

Course Code: MEE-S305T **Breakup:** 3– 0 – 0 – 3

Course Name: Heat Transfer

Course outcome (CO): At the end of the course, the student will be able to:

CO-1	Understand the concepts of Basic Heat Transfer mechanisms and their applications
CO-2	Understand and Solve heat transfer by conduction in solids for steady state and transient conditions.
CO-3	Understand the effect of thermal conductivity on heat transfer mechanisms
CO-4	Explain and solve heat transfer by forced and natural convection
CO-5	Discuss and solve heat transfer problems of convection using dimensional analysis
CO-6	Analyse the performance of heat exchange equipments.

Course Details:

Course Details:

UNIT-I 9

Introduction to Heat Transfer

Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism

Conduction

One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions.

Steady State one-dimensional Heat conduction

Composite Systems in rectangular, cylindrical and spherical coordinates without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance;

Critical thickness of insulation. Concept of overall heat transfer coefficients.

UNIT-II 9

Fins Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells

Natural Convection

Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere; Combined free and forced convection.

UNIT-III 12

Forced Convection

Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Empirical heat transfer relations; Flow inside ducts; Relation between fluid friction and heat transfer.

Condensation and Boiling

Introduction to condensation phenomena; Heat transfer relations for laminar film, condensation on vertical surfaces and on outside & inside of a horizontal tube, Heat pipes; Boiling modes, pool boiling

Heat Exchanger

Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers.

UNIT-IV 10

Thermal Radiation

Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; Gray body; Shape factor; Black- body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation

Introduction To Mass Transfer

Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.

Text Books and Reference:

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J. P. Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F. P. Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. P.K. Nag, Heat & Mass Transfer, 2018.
5. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002

Course Code: MEE-S305P
Course Name: Heat Transfer Lab

Type:	L	T	P	Credits
Breakup:	**0**	**0**	**3**	**2**

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following

1. Conduction: Composite wall experiment
2. Conduction: Composite cylinder experiment

3. Convection: Pool Boiling experiment
4. Convection: Experiment on heat transfer from tube-natural convection
5. Convection: Heat pipe experiment
6. Convection: Heat transfer through fin natural convection
7. Convection: Heat transfer through tube/fin-forced convection
8. Any experiment on Stefan's Law on radiation determination of emissivity etc.
9. Any experiment on solar collector etc.
10. Heat exchanger-Parallel flow experiment
11. Heat exchanger-counter flow experiment

Course Code: MEE-S306 Breakup: 3– 1 – 0 – 4

Course Name: Design of Machine Elements

Course outcome(CO): At the end of the course, the will be able to:

CO-1	Apply knowledge of machine design for understanding, formulating and solving engineering problems
CO-2	Acquire knowledge and hands-on competence in applying the concepts in the design and development of mechanical systems.
CO-3	Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular.
CO-4	Identify, analyze, and solve mechanical engineering problems useful to the society.
CO-5	Work effectively with engineering and science teams as well as with multidisciplinary

Course Details:

UNIT-I

Introduction: Definition, Methods, standards in design, considerations in design.

Selection of materials: Importance, Classification of Engineering Materials, different kind of steels & cast irons, steel designation, Materials for components subjected to creep, static and fatigue loads, Importance of ceramics, plastics & rubbers for Engineering applications, ASTMtesting methods.

UNIT-II

Design for static load: Modes of failure, Factor of safety, stress-strain relationship, principal stresses, theories of failure.

Design for dynamic loads: types, effect w.r.t. static loads, stress concentration, Fluctuating / alternating stresses, fatigue failure, endurance limit, design for finite & infinite life, Soderberg& Goodman criteria, design for fatigue, creep and fracture, design for contact stresses and residual stresses

UNIT-III

Joints**:** Riveted joints, failure of rivets, welded joint, screwed joints, eccentric loading of above joints, and design for fatigue loading, Shaft, keys & coupling:Design against static and fatigue loads, strength & rigidity design, Selection of square & flat keys & splines, rigid & flexible couplings.

UNIT-IV

Mechanical springs: Design of Helical and leaf springs, against static & fatigue loading.

Design analysis of Power Screws: Form of threads, square threads, trapezoidal threads, stresses in screw, design of screw jack.

Introduction to Product Development & Design Process : Definition of Design, Design Process, Need Analysis, Need based developments, Design by Evolution, Technology based developments, Examples. Case Studies.Brain-storming.

Text Books and Reference:

1. V. B. Bhandari, Design of Machine Elements, TMH. 2020
2. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
3. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
4. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
5. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
6. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

Course Code: MEE-S307T **Breakup:** 3 – 0 – 0 – 3

Course Name: Refrigeration and air conditioning

Course outcome (CO): At the end of the course, the student will be able to:

CO-1	Understand the principles and applications of refrigeration system
CO-2	Analyse performance of vapour compression refrigeration system
CO-3	Analyseair conditioning process using principles of psychometry
CO-4	Study the working principles of vapour absorption, thermoelectric
CO-5	Evaluate the cooling and heating loads in air-conditioning system

Course Details:

Introduction , carnot refrigeration cycle, COP, application
Air refrigeration cycle , Bell Coleman air refrigeration cycle , Brayton refrigeration cycle , optimum COP and pressure ratio , air craft refrigeration system , Classification of air craft refrigeration system , Actual power for refrigeration system, Dry air rated temperature(DART).
Refrigerants-Classification , nomanclature , desirable properties of refrigerants , common refigerants, secondery refrigerants & CFC free refigerants
Vapour compression system- Single stage system , analysis of vapour compression cycle , effect of pressure change on COP , Use of T-S & p-h charts , effect of subcooling of condensate on COP& capacity , effect of superheeting of vapour compression , construction details of refrigerator and air conditioners, Multi stage compression.
Vapour absorption system-Working Principles of continuous absorption system , comparision between absorption and compression system. Theory of mixtures , Temp. concentration diagram , Enthalpy concentration diagram. Adiabetic mixing of two systems , Lithium bromide water vapour absorption system. Working principles , Comparison with ammonia water system.
Air conditioning- Introduction to air conditioning , Psychromatrics , terms , definitions , adiabetic saturations& thermodynamics , wet bulb temperature , psychrometers , use of psychrometric charts , air conditioning requirements for comfort and industrial processes, comfort charts , comfort zones , cooling towers ,cooling and heating load calculations.
Refrigeration equipment & application—Expansion devices , duct design , food preservation cold storage , refrigerators , freezers , ice plants , water coolers , thermal analysis for human bodies, automotive air conditioning – brief overview. , Introduction to soler radiation distributions , emperical methods to evolute heat transfer throw walls & roofs, infiltration , passive heating and cooling of building.

Text Books and References:

1. Refrigeration and air conditioning, 2011, Manohar Prasad; New Age International publishers.
2. Principles of refrigeration, 4th edition 1997, Roy J Dosset; Prentice Hall

3. Refrigeration and air conditioning,2009, C. P. Arora McGraw Hill Education(India) Private Limited

Course Code: MEE-S402P **Breakup: 0 – 0 – 3 – 2**

Course Name: Refrigeration and air conditioning Lab

Course Details:

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.
3. To study different types of evaporators used in refrigeration system.
4. To study basic components of air-conditioning system.
5. Experiment on air conditioning test rig and calculation of various performance parameters.
6. To study air washers.
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compression.
9. Experiment on ice-plant.
10. Experiment on two stage reciprocating compressors for determination of volumetric efficiency, p-v digram and effect of inter cooling.
11. Study of hermetically sealed compressors.
12. Experiment on desert coolers.

Course Code: HSS – S301 Breakup: 1 – 1 – 3 – 2

Course Name: Professional Communication

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the nuances of English language for enhancing presentation skills
CO2	Speak in standard English with clarity and fluency and to write business messages professionally
CO3	Speak and communicate clearly in different professional contexts which would improve their chances of employability
CO4	Understand the importance of ethical practices in their professional life

Course Details:

Unit 1- Presentation Techniques

- Meaning and importance of presentation technique
- Use of presentation techniques in everyday life
- Presentation skills required for business organization
- Types of business presentations-meetings, seminars, Conferences

Unit 2-Oral presentations

- Effective oral presentation techniques
- Tips for good oral delivery; debates, elocution, impromptu speeches
- Levels and models of organizational Communication
- Interviews-types of interviews
- Group discussions

Unit 3- Written communication

- Style and tone of writing business messages and Documents.
- Writing for websites, internet e-mails and short messages
- Applications, letters, memos
- Proposals and report writing

Unit 4 - Nonverbal presentations

- Nonverbal communication techniques
- Business manners, ethics and personality development
- Audio/visual presentations, power point presentations
- Art of delivery

Unit 5- Literary concepts

- Stories, essays, comprehension
- Reading techniques-skimming and scanning methods
- Listening skills

Text Books and References:

1. "Business Communication Today", Bove'e, Thill and Schatzman: Pearson Education(Singapore),2003

2. "Business Communication-a framework of success", H.Dan O'Hair, James S.O'Rourke and Mary John O' Hair: South Western College Publishing 2001.

3. "Basic Business Communication", Raymond V.Lesikar, Marie E.Flatley: Tata McGraw Hill Publishing Company Ltd., 2002.

Detailed Syllabus
4th Year

Course Code: MEE-S401T **Breakup: 3 – 0 – 0 – 3**

Course Name: Computer aided manufacturing

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	To Study the Automation and need and future of NC Systems, To educate students by covering different aspects of computer Aided Manufacturing.
CO-2	Basic knowledge of NC and CNC machines and its components
CO-3	Improves the quality of manufacturing and To educate students by covering robotics and different material handling system required in manufacturing shop floor.
CO-4	To create strong skills of writing NC/CNC programs, Basic knowledge of Manual part programming and Basic knowledge of APT programming
CO-5	To educate students to understand different advances in manufacturing system like: GT, CAPP and FMS.

Course Details:

Fundamental concepts of numerical control. Direct numerical control (DNC) and computer numerical control (CNC) ,Adaptive control of manufacturing process, Manufacturing system concepts, Computer process monitoring and control, Offline use of computers, computer process interface , programming introduction to FMS.
Laboratory component shall emphasize on computer numerical machines and FMS,robotics.

Text Books and References:

1. CAD/CAM/CIM , 2007, Radha Krishnan and Subramanyam S.; Wiley eastern ltd., india
2. Koren Y. ,Benuri J., Numarical control of machinestools , 1984; Khanna publishers , ND
3. Roger S. Pressman , Numarical control and computer aided manufacturing; John Willey AND SONS

Course Code: MEE-S401P **Breakup: 0 – 0 – 3 – 2**

Course Name: Computer aided manufacturing Lab

Course Details:

1. To study the characteristic features of CNC machine
2. Part programming(in word address format) experiment for turning operation(including operations such as grooving and threading) and running on CNC machine
3. Part programming(in word address format or ATP) experiment for drilling operation (point to point) and running on CNC
4. Part programming(in word address format or ATP) experiment for milling operation (contouring) and running on CNC
5. Experiments on Robot & programs
6. Experiment on transfer line/material handling
7. Experiment on difference between ordinary and NC machine, study or retrofitting
8. Experiment on study of system devices such as motors and feed back devices
9. Experiment on Mecatronics and controls

Course Code: **MEE-S403** **Breakup:** **3 – 0 – 0 – 3**

Course Name: **Industrial management and production system**

Course outcome(CO): At the end of the course, the student will be able to:

CO-1	Understand the concepts of management system and production system
CO-2	Understand the basics of production planning and control
CO-3	Understand the work measurement and it's tools
CO-4	Concepts of Resource allocation and linear programming
CO-5	Understand the Job decision &project management using PERT & CPM
CO-6	Analyze the Quality, Line balancing and quantitative forecasting techniques

Course Details:

Concepts of management system and production system , Production planning and control , Work and time study , Resource allocation and linear programming , Plant lay out and material handling , Job decision & project management,Sequencing problems- Travelling salesman problem, Machine-scheduling problem (Job shop), Network based planning models, Objectives of CPM and PERT, Characteristics of CPM/PERT projects, Network diagram, Terminology, Critical path, Project duration, PERT Network, Activity time, Probabilities of project completion, Optimal crashing of project activities. Inspection and Quality control, forecasting and line balancing.

Text Books and References:

1. Industrial engg. & management , 2007, O. P. Khanna; DhanpatRai& sons.
2. PERT &CPM Principles and applications , 2009, L. S. Srinath; EWP
3. Production and operation management , 1992, Everett E. Adam Jr., Ronald jobert ; PHI

Course Code: HSS-S401 **Breakup:** 3 – 1 – 0 – 4

Course Name: Industrial Economics

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	To help students gain an understanding in certain core concepts of Industrial Economics.
CO-2	To familiarize students with theories in Industrial Economics.
CO-3	To help students understand cost structures and their role and importance in firm decisions.
CO-4	To analyze the performance of the Indian Industrial Economy against the backdrop of contemporary development.

Course Details:

Unit -I
Definition and scope of engineering economics
Concept of supply and demand
Price elasticity and cross elasticity of demand
Production
Engineering costs and cost estimation
Concept of time value of money
Cash flow analysis

Unit-II
Perfect competition
Monopoly
Monopolistic competition

Unit-III
National Income, GDP
Inflation, Deflation and treatment

Unit-IV
Functions of RBI
Indian Tax System

Text Books and References:

1. Henderson, M. James and Quandt, E. Richards, "Microeconomic Theory: A Mathematical Approach".
2. Koutsoyiannis, A., "Modern micro economics".ardwick, Philip., Khan Bahadure., Langmeed, John, "An Introduction to modern economics".
3. Samuelson, A. Paul, "Economics".
4. Shapiro, Edward. "Macro economics".

5. Newnan, G. Donald, Eschenbach, G.Ted, Lavelle, P. Jerome, “Engineering Economic Analysis”.

Course Code: **PRT-S402** **Breakup:** **0– 0 – 6 –4**

Course Name: **B.Tech Project-II**

Course Code: **SST-S301** **Breakup:** **0 – 0 – 2 – 2**

Course Name: **Summer Training**

Course Details:

6-8 Weeks practical training in a reputed industry/organisation is to be undertaken during summer after completing six semestersof study. The student will submit detailed report and givepresentation on training.

Course Code: MEE- S403T **Breakup:** 3 – 0 – 0 – 3

Course Name: Metrology, Measurement and Controls

Course Outcomes (CO): At the end of the course, the student will be able to:

CO-1	Understand the applications of computer in the design.
CO-2	Understand and develop the Mathematical representations of curves used in geometric construction.
CO-3	Understand and develop the Mathematical representations of solids used in geometric construction.
CO-4	Able to get the transformed in 2D and 3D using transformation equations
CO-5	evaluate design, analyze and optimize using commercial CAD software.
CO-6	Apply the knowledge of Mathematics and Engineering to solve problems in structural by FEM

Course Details:

UNIT-I 6

Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors.

Sensors and Transducers

Types of sensors, types of transducers and their characteristics

Signal transmission and processing

Devices and systems, Signal Display & Recording Devices

UNIT-II 6

Time related measurements

Counters, stroboscope, frequency measurement by direct comparison, Measurement of displacement

Measurement of pressure

Gravitational, directing acting, elastic and indirect type pressure transducers

Strain measurement

Types of strain gauges and their working, strain gauge circuits, temperature compensation

Measurements of force and torque

Different types of load cells, elastic transducers, pneumatic& hydraulic systems

Temperature measurement

Thermometers, bimetallic thermocouples, thermistors and pyrometers

UNIT-III 6

Standards of linear measurement, line and end standards. Limits, fits and tolerances. Interchangeability and standardization, Linear and angular measurements devices and systems Comparators: Sigma, Johansson‘s Microkrator, Limit gauges classification, Taylor‘s Principle of Gauge Design

UNIT-IV 6

Metrology-II
Measurement of geometric forms like straightness, flatness, roundness, Tool makers microscope, profile project autocollimator, Principle and use of interferometry, optical flat, Measurement of screw threads and gears, Surface texture: quantitative evaluation of surface roughness and its measurement.
Measurement and Inspection
Dimensional inspection–Tolerance, Limit gauging, comparators, Surface roughness, Feature inspection
UNIT-V 14

Input-output Relationship-
Laplace transforms, Inverse Laplace transform. Block diagrams, Transfer functions, Signal flow graphs, state variable characterization of dynamic systems. Modeling of mechanical system elements, **Error Analysis-**anderror sensing devices in control systems.
Stability Theory-Stability,Routh Hurwitz criterion, Nyquist criterion. Root locus techniques,**Frequency Domain analysis-**frequency domain analysis, Bode plot, M-circles and N-circles.

Text Books and References:

1. Mechanical Measurement, published 2012, Jain, R.K ; Khanna Publishers.
2. Mechanical Measurements and Control, 1979, Kumar D.S.; Metropolitan book company, Pvt. Ltd., N. Delhi.
3. Engineering Metrology - Hume K.J. (MacDonald and Co. 1963)
5. Engineering Metrology- Gupta, I.C. (DhanpatRai& Sons, New Delhi, 1994)
7. Measurement Systems, Application Design, 5th edition 2004, Doeblein E.O; McGraw Hill.
8. Automatic control Engineering, 1990, K. Ogatta ; Prentice Hall.
9. Automatic control Engineering, 1995, B. C. Kuo ; Wiley.

Course Code: MEE-S403 P
Course Name: Metrology, Measurement and Control lab

Type:	L	T	P	Credits
Breakup:	**0 –**	**0 –**	**3**	**– 2**

Course Details:

Minimum 8 out of following:

1. Study & working of simple measuring instruments-Vernier calipers, micrometer, tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire methods.
3. Measurement of angle using sine-bar & slip gauges, Study of limit gauges.
4. Study & angular measurement using level protector.
5. Adjustment of spark plug gap using feeler gauges.
6. Study of dial indicator & its constructional details.
7. Use of dial indicator to check a shape run use.
8. Study and understanding of limits, fits & Tolerances.

9. Study of Pressure & Temperature measuring equipment.
10. Strain gauge measurement.
11. Speed measurement using stroboscope.

Course Code: MEE- S405 **Breakup: 3 – 0 – 0 – 3**

Course Name: Gas Dynamics & Turbo machinery

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	Understand the basics of the hydro machinery and the components, function and use of different types of turbines and pumps
CO-2	Explain the working principles of turbomachines and apply it to various types of machines
CO-3	Identify and describe hydraulic turbines and their classifications
CO-4	Perform the preliminary design of turbomachines (pumps, compressors, turbines) on a 1-D basis
CO-5	Estimate the hydraulic parameters and select the required hydraulic machine(pump)

Course Details:

Unit I 8

Impact of jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat &curve), Effect of inclination of jet with the surface.

Hydraulic Turbines: Classification of turbines, Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel.

UNIT-II 8

Reaction Turbines: Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.

Unit III 8

Centrifugal Pumps: Classifications of centrifugal pumps, Vector diagram, Work done by impellor,Efficiencies of centrifugal pumps, Specific speed, Cavitation & separation and their control, Performance characteristics.

Reciprocating pump: Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison ofcentrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane pumps, Performancecharacteristics.

Unit IV

Basic concepts and Isentropic Flows 8

Energy and momentum equations of compressible fluid flows – Stagnation states,

Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers

Unit V 8

Jet Propulsion
Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine.
Gas Nozzles
Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, Choked flow, throat area, Nozzle efficiency

Text Books & References

1. Mechanics and Thermodynamics of Propulsion, 2009, P. G. Hill and R.; Addison-wesley.
2. Gas turbine Theory & Practice, published 2001, Cohen & Rogers ; Prentice Hall
3. Introduction to Fluid Mechanics and Fluid Machines, 2008, S.K. Som& G. Biswas (TMH) ; reprint 2017.
4. Hydraulic Machines,1985, JagdishLal ; S.K. Kataria& Sons

Course Code: **MEE- S404 P**
Course Name: **Gas Dynamics and Turbo machinery lab**

Type:	**L**	**T**	**P**	**Credits**
Breakup:	**0 –**	**0 –**	**3**	**– 2**

Course Details:
Minimum 8 experiments of the following
1. Impact of jet experiment.
2. Turbine experiment on pelton wheel.
3. Turbine experiment on Francis turbine.
4. Turbine experiment on Kaplan turbine.
5. Experiment on Reciprocating pump.
6. Experiment on centrifugal pump.
7. Experiment on Hydraulic jack/Press.
8. Experiment on Hydraulic Brake.
9. Experiment on Hydraulic Ram.
10. Experiment on Compressor.
11. Experiment for measurement of drag and lift on aerofoil in wind tunnel.

Text Books & References

1. Mechanics and Thermodynamics of Propulsion, 2009, P. G. Hill and R.; Addison-wesley.
2. Gas turbine Theory & Practice, published 2001, Cohen & Rogers ; Prentice Hall

3. Introduction to Fluid Mechanics and Fluid Machines, 2008, S.K. Som& G. Biswas (TMH) ; reprint 2017.
4. Hydraulic Machines,1985, JagdishLal ; S.K. Kataria& Sons

Course Code: MEE- S406T **Breakup:** 3 – 0 – 0 – 3

Course Name: COMPUTER AIDED DESIGN

Course outcome (CO): At the end of the course, the student will be able to:

CO-1	Understand the applications of computer in the design.
CO-2	Understand and develop the Mathematical representations of curves used in geometric construction.
CO-3	Understand and develop the Mathematical representations of solids used in geometric construction.
CO-4	Able to get the transformed in 2D and 3D using transformation equations
CO-5	evaluate design, analyze and optimize using commercial CAD software.
CO-6	Apply the knowledge of Mathematics and Engineering to solve problems in structural by FEM

Course Details:

Introduction, Computer Graphics,Curve representation,Interpolation vs approximation, Spline curve,Bezier curves and its properties,Brief mention of other curves.3-D Graphics,Solid modelling-sweep representation wire mesh , constructive solid geometry and Boolean operations, boundaryrepresentation ,colors.

Computer aided design of machine elements such as shaft,springs,bearings and problem from other systems such as heat exchanger, inventory control etc. Writing computer programe in C,Auto Cad and its uses.

Introduction to numerical method and optimization technique, curve fitting,least square method. Newton – Raphson method for root finding and for optimization.Brief Introduction to numerical differtiation and integration.Linear programing for constrained optimization (only graphical method)

Introduction to finite element method, one and two dimensional beam element (spring system) analysis.

TEXT BOOKS and References :-

1. Computer graphics ; Hearn & Baker, Second Edition, 1997, Prentice Hall of India
2. CAD/CAM: Computer –Aided Design and Manufacturing,1984, M. P. Groover
3. Computer Aided analysis & design of machine elements, 2010, Rao&Dukhipati
4. C Language and Numerical Methods, reprint 2003 ; C. Xavier; New Age International Publisher
5. Engineering Optimization, 2013, SS Rao; New Age International Publisher

Course Code: **MEE- S406P** **Breakup:** **0 – 0 – 3 – 2**

Course Name: **COMPUTER AIDED DESIGN LAB**

Course Details:

1. Line drawing or circle drawing experiment.
2. Geometric transformation algorithm experiment for translation.
3. Design of machine component or other system experiment.
4. Understanding and use of any 3-D Modelling Software commands.
5. Pro/E/Idea etc experiment.
6. Writing a small program for FEM for 2 spring system.
7. Root findings or curve fitting experiment.
8. Numerical differentiation or numerical integration experiment.

Course Code: PRT-S402 Breakup: 0– 0 – 6 –4

Course Name: B.Tech Project-II

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	design and conduct experiments, interpret and analyze data and report results
CO2	use modern engineering software tool and equipment to analyze mechanical engineering problems
CO3	communicate effectively in both verbal and written form
CO4	imbibe capability of self-education and lifelong learning

List of Departmental Elective Courses (Mechanical Engineering)

Course Code	Course Name	Course Credits	Number of (weekly		
			Lecture	Tutorial	Practical /Discussion
MEE-S502	Automobile Engineering	4	3	0	0
MEE-S504	Operation Research	4	3	0	0
MEE-S505	Machine Tool Design	4	3	0	0
MEE-S506	Finite Element Methods	4	3	0	0
MEE-S509	Computational Fluid Dynamics	4	3	0	0
MEE-S510	Advanced Solid Mechanics	4	3	0	0
MEE-S511	Advanced Fluid Mech.	4	3	0	0
MEE-S512	Fluid Machinery	4	3	0	0

1. ## List of Open Electives offered by various Departments in VI & VII Semester

Name of Departments	OEC-I (even sem.)	OEC-II (odd sem.)
Computer Science Engg.	Data Structures: CSE-S208, 4(3-0-0)	Artificial intelligence: CSE-S528, 4(3-0-0)
	Python: CSE-S524, 4(3-0-0)	Python: CSE-S524, 4(3-0-0)
Electronics Engg.	Power Electronics: ECE-S501, 4(3-0-0)	Micro Processors & Applications: ECE-S304, 4(3-0-0)
Material Science and Metallurgical Engineering	Ceramic materials: MSME-S505, 4(3-0-0)	Application of transport phenomena in metal processing: MSME-S502, 4(3-0-0)
	-	Electrochemical technology in materials processing: MSME-S501, 4(3-0-0)
Mechanical Engg.	Robotics/mechatronics:MEE-S501, 4(3-0-0)	Optimization Method in Engineering: MEE-S507, 4(3-0-0)
	Design and manufacturing of Composites: MEE-S508, 4(3-0-0)	Non-Conventional Energy Resources: MEE-S503, 4(3-0-0)

Course Code: **MEE- S501** **Breakup:** **3 – 0 – 0 –4**

Course Name: **Robotics**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Demonstrate knowledge of industrial robots, characteristics, end effectors and actuators.
CO2	Apply spatial transformation to obtain forward and inverse kinematics
CO3	Solve robot dynamics problems, generate joint trajectory for path planning
CO4	Describe working principle of various sensors and program different operations
CO5	Appreciate applications of robots in industry

Course Details:

Introduction-Robot Physical Configurations, End effectors sensor & actuators, Other technical features, Types and generations of robots, structures and operation of robot, robot applications for Material Transfer, Machine Loading, Welding, Spray Coating, Processing Operations, Assembly and inspection, basic robot motions, economics-Economics aspect of robots,Economics justification of robot, Economic justification methods, robot programming methods, VAL and AML with examples, Artificial intelligence & Its Application in Manufacturing.

TEXT BOOKS :-

K. M. Lynch and F. C. Park, Modern Robotics: Mechanics, Planning, and Control. Cambridge University Press. 2017.

Course Code: **MEE- S502** **Breakup:** **3 – 0 – 0 –4**

Course Name: **Automobile Engineering**

Course outcome(CO): At the end of the course, the student will be able to:

CO-1	Explain the construction, working, feature, relative merits and application of different types of chassis, bodies, frames, clutches and brakes of automobile and use suitable diagram to support their description.
CO-2	Explain construction, working and features of different elements of power transmission in automobile namely gear boxes, fluid coupling, hydraulic torque convertor, overdrive, front and rear wheel drive, propeller shaft, differential, power transmission through rear and front axle and automatic transmission system.
CO-3	Explain the concept of steering geometry including camber/ caster, king pin inclination, toe in/ toe out, tyre threads and retreading, causes of tyre wear and tear, construction and features of different types of tyres, wheels, steering mechanism and suspension systems with neat sketches as required.
CO-4	Explain the construction, features and working of automotive electrical and electronics system of an automobile and their different parts, namely battery, alternator, starter, ignition systems, electric wiring, head lamps and electric horn.
CO-6	Explain the importance and working of automobile air conditioning system and different safety devices such as Antilock Braking System, Air Bags and Belts with reference to automotive safety requirements.

Course Details:

History of development , automobile engines , frame , transmission systems ,drive line and rear axle , wheel and tires, Steering system, suspension system , brakes, storage battery , Starter motor , Wiring for auto electrical systems.

Text Books and References:

1. Heldt.P.M.- “Automotive Chassis”- Chilton Co., New York- 1990
2. K.K.Ramalingam - “Automobile Engineering” – Scitech Publication, Chennai - 2001.
3. Steed W - “Mechanics of Road Vehicles”- Illiffe Books Ltd., London- 1960
4. Newton Steeds and Garrot- “Motor Vehicles”- Butterworths, London- 2000.
5. Judge A.W- “Mechanism of the Car”- Chapman and Halls Ltd., London- 1986

Course Code: **MEE- S503** **Breakup:** **3 – 0 – 0 –4**

Course Name: **Non-Conventional Energy Sources**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Able to understand the renewable energy sources available at present.
CO2	Able to understand the solar energy operation and its characteristics.
CO3	To educate the wind energy operation and its types.
CO4	To educate the tidal and geothermal energy principles and its operation.
CO5	Able to understand the biomass energy generation and its technologies.

Course Details:

Indian and global energy sources, energy exploited, energy demand, energy planning, introduction to varios sources of energy. Bio-gas,Wind energy,solar energy ,Ocean energy, fuel cells, thermionic systems, Gas thermal energy.

Text Books and References:

1. P.D.Dunn, Renewable Energies: Sources, Conversion and Application, P.Peregrinius Ltd, London, 1986.
2. J.W.Twidell and A.D.Weer, Renewable Energy Sources, ELBS, 2nd Edition, Taylor & Francis, 2006.
3. S. Rao and B. B.Parulekar, Energy Technology- Non conventional, 4. Renewable and Conventional 3rd Edition, Khanna Pub, 1999.
4. B.T. Nijaguna, Biogas Technology, New Age International Pub, 2002.

Course Code: **MEE- S504** **Breakup:** **3 – 0 – 0 –4**

Course Name: **Operation Research**

Course outcome (CO): At the end of the course, the student will be able to:

CO-1	Define and formulate linear programming problems and appreciate their limitations.
CO-2	Solve linear programming problems using appropriate techniques and optimization
CO-3	Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship.
CO-4	Solve Transportation Problems
CO-5	Develop mathematical skills to analyse and solve Queing models arising from a wide range of applications.

Course Details:

Simplex algorithm, revisedsimplex algorithm, duality theory, dual simplex algorithm, sensitivity analysis , transportation and assignment problems,network models ,principle of optimality and its applications, queuingsystems, sequencing theory.

TEXT BOOKS :-

1. Taha,H A, "Operations Research - An Introduction", Sixth Edition, Prentice Hall of India Private Limited, N. Delhi, 2004.
2. Hillier, F S, "Operations Research", First Indian Edition, CBS Publishers & Distributors, Delhi, 1994.
3. Wagner H M, "Principles of Operations Research", Second Edition, Prentice Hall of India Private Limited, New Delhi, 2003.
4. Gupta P K, &Hira D.S., "Operations Research", Third Edition, S Chand & Company Ltd., New Delhi, 2005.

Course Code: **MEE- S505** **Breakup:** **3 – 0 – 0 –4**

Course Name: **Unconventional Manufacturing Process**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Get the basics of types of machines.
CO2	Get the idea about various non-conventional machines and their applications.
CO3	Learn about the different types of unconventional machining processes.
CO4	The concept of Material removal by an edged tool, involving plastic deformation and formation of chips, has been known to man for several hundred years.

Course Details:

Introduction, Principle and working and application of unconventional machining process such as electro discharge machining, electro chemical machining, ultrasonic machining, abrasive jet machining etc.

Principle and working of unconventional welding process such as laser beam ,electron beam , ultrasonic, plasma arcwelding ,explosive welding under water welding,Unconventional forming process.

Text Books and References:

1. Fundamentals of Machining Processes-Conventional and non – conventional processes/Hassan Abdel – Gawad El-Hafy/CRC Press-2016.
2. Modern Machining Process / Pandey P.C. and Shah H.S./ TMH. 2020

Course Code: **MEE- S506** **Breakup:** **3 – 0 – 0 –4**

Course Name: **Finite Element Methods**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To develop some experience with a commercial FEM code and some practical modeling exercises.
CO2	To analyze the displacement-based finite element method for displacement and stress a0lysis and to introduce related analytical and computer tools.
CO3	To use 1-D and 2D element stiffness matrices and load vectors from various methods to solve for displacements and stresses calculations.
CO4	To understand Formulation of elemental stiffness matrix and load vector for Plane stress/strain such as Linear Strain Rectangle (LSR), Constant Strain Triangles (CST), Pascal's triangle , primary and secondary variables, properties of shape functions
CO5	To interpret approximate future of the finite element method and convergence of results are examined

Course Details:

Introduction,Calculus of variation,Ritz method,weighted residual methods,Fundamental concepts of the FEM,discretization of the domain,one and two and three dimensional elements and interpolation functions,compatibility and completeness requirements.Assembly and boundry conditions,formulation of FEM solutions,application to simple boundry value problems,computer implementation.

Text Books and References:

1. Introduction to Finite element analysis ,Martin and Carey Tata McGraw Hill, 2020
2. The finite element method for engg. Huebner,Johnwilley. 2016

Course Code: MEE- S508 Breakup: 3 – 0 – 0 –4

Course Name: Design and manufacturing of Composites

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Explain the advantages and applications of composite materials.
CO2	Describe the properties of various reinforcements of composite materials.
CO3	Summarize the manufacture of metal matrix, ceramic matrix and C-C composites.
CO4	Describe the manufacture of polymer matrix composites.
CO5	Formulate the failure theories of composite materials.

Course Details:

Structures and method of preparation of fibers and fiber reinforced composites. Micromechanics and prediction of elastic constants,strength of composites, properties of laminated composites and their constitutive equations, Laminates, Interfacial mechanics and properties, applications.

Text Books and References:

1. R.W.Cahn, Material Science and Technology – Vol 13 – Composites, West Germany, 1994.

2. WD Callister, Jr., Adapted by R. Balasubramaniam, Materials Science and Engineering, John Wiley & Sons, NY, Indian edition, 2007
3. Ceramic matrix composites, K.K. Chawala, 1st ed., (1993) Chapman & Hall, London.
4. Advances in composite materials, G. Piatti, (1978) Applied Science Publishers Ltd., London.

Course Code: MEE- S507 Breakup: 3 – 0 – 0 –4

Course Name: Optimization Method in Engineering

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Identify different types of optimization problems
CO2	Explain different optimization techniques
CO3	Solve various multivariable optimization problems
CO4	Solve problems by using Linear Programming
CO5	Solve optimization problems of staged and discrete processes, understand the concept of specialized & Non-traditional Algorithms

Course Details:

Classical optimization methods,unconstraineminimization, univarite, conjugate dirction, gradient and variable metric methods, constrained minimization, feasible direction and projections. Integer and geometric programing,genetic algorithms, simulated annealing techniques, design applications.

Text books & References:

1. Engineering Optimization (4th Edition) by S.S.Rao, New Age International, 2014
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI Publishers 2014
3. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers, 2015
4. Operations Research by Hillar and Liberman, TMH Publishers, 2018
5. Optimal design – JasbirArora, McGraw Hill (International) Publishers, 2020

Course Code: MEE- 509 Breakup: 3 – 0 – 0 –4

Course Name: Computational Fluid Dynamics

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To help the students understand the fundamentals and relevance of fluid mechanics in the broader context of engineering sciences in general, and automotive engineering in particular
CO2	To enable students to understand fluid properties and apply laws of fluid mechanics and analyze fluid flows through different configurations along with the measurement of flow parameters.
CO3	To empower students with the expertise of experimentation, simulation and the fundamental concepts that are required to translate a novel engineering idea to reality through dimensional analysis and similitude.
CO4	To expose students to a wide variety of research areas and concerns in and around fluid mechanics such as energy, health etc. across multidisciplinary domains.
CO5	To equip students with necessary engineering skills such as solving engineering problems in a professional way, using commercial software packages such as ANSYS Fluent, MATLAB etc. for data analysis and presentation, numerical simulations etc

Course Details:

Conservation laws, Weak solutions & shocks, Monotone difference schemes, Total variatiation diminishing schemes, Godunov-type schemes,essentially non-oscillatory methods, flux limiters.

Text books & References:

1. John D Anderson, Jr., Computational Fluid Dynamics -The Basics with Applications, McGraw Hill, 1995.
2. H. K. Versteeg and W. Malalasekera, An Introduction to Computational Fluid Dynamics - The Finite Volume Method, Longman Scientific and Technical, 1995.
3. Joel H. Ferziger and MilovanPeric, Computational Method for Fluid Dynamics, 3rd Edition, Springer, 2002.
4. Dale A. Anderson, John C. Tannehill and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer, 2nd Edition, Taylor and Francis, 1984.

Course Code: **MEE- S504** **Breakup:** **3 – 0 – 0 –4**
Course Name: **Operation Research**

Course outcome (CO): At the end of the course, the student will be able to:

CO-1	Define and formulate linear programming problems and appreciate their limitations.
CO-2	Solve linear programming problems using appropriate techniques and optimization
CO-3	Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship.
CO-4	Solve Transportation Problems
CO-5	Develop mathematical skills to analyze and solve Queuing models arising from a wide range of applications.

Course Details:

Simplex algorithm, revisedsimplex algorithm, duality theory, dual simplex algorithm, senestivity analysis , transportation and assignment problems ,network models ,principle of optimality and its applications , queueing systems, sequencing theory.

Text books & References:

1. Taha,H A, "Operations Research - An Introduction", Sixth Edition, Prentice Hall of India Private Limited, N. Delhi, 2004.
2. Hillier, F S, "Operations Research", First Indian Edition, CBS Publishers & Distributors, Delhi, 1994.
3. Wagner H M, "Principles of Operations Research", Second Edition, Prentice Hall of India Private Limited, New Delhi, 2003.
4. Gupta P K, &Hira D.S., "Operations Research", Third Edition, S Chand & Company Ltd., New Delhi, 2005.

Course Code: MEE- S505 **Breakup:** 3 – 0 – 0 –4
Course Name: Machine Tool Design

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Apply cutting mechanics to metal machining based on cutting force and power consumption.
CO2	Operate lathe, milling machines, drill press, grinding machines, etc.
CO3	Select cutting tool materials and tool geometries for different metals.
CO4	Select appropriate machining processes and Learn machine tool structures and machining economics.
CO5	Write simple CNC programs and conduct CNC machining.

Course Details:

Kinetics of machine tools, drive , controls , selective and preselections , operating devices , spindle and spindle bearing . Design of gear box , beds , columns , tables and guides. Inspection and testing of machine tools , automation and programme control.

Text books & References:

1. Lindberg Roy A, "Processes and materials of manufacture", Fourth edition PHI, 1990.
2. Ostwald Phillip F, "Manufacturing processes and systems", John Wiley and Sons, ninth edition (1998).
3. Rao P N, "Manufacturing technology", Tata McGraw-Hill, 2002.
4. Gerling, "All About Machine Tools", New Age International (P) Limited, sixteenth edition, 2000.
5. Chapman W A J, "Workshop Technology", Part1, 2,3, CBS Publishers and distributors.,2000

Course Code: **MEE-S510** **Breakup:** **3 – 1 – 0 –4**

Course Name: **Advanced Solid Mechanics**

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	Understand the concept of state of stress, strain, and significance of compatibility conditions.
CO-2	Understand The concept of energy methods for solving problems.
CO-3	Understand the theory of bending of curved bars for solving problems.
CO-4	Learn the underlying theory of unsymmetrical bending and concept of shear centre

Course Details:

Equations of elasticity , uniqueness and superposition , Airy stress function approach, plain stress and plain strain problems , principle of virtual work energy , plate theory , torsion of non circular bars , membrane analysis , unsymmetrical bending , curved bars , thick cylinders , rotating discs , elastic stability , failure theories , introduction to strain gauges , photoelasticity.

Text Book and References:

1. Boresi A P and Sidebottom O M –Advanced mechanics of materials , John willey and sons 1985
2. Srinath L S –Advanced mechanics of materials , 1952
3. Seeley F B and Smith J O –Advanced mechanicsof materials , 1952
4. Richard G Budynas – Advanced strength and applied stress analysis , McGraw Hill,ND

Course Code: MEE-S511 **Breakup:** 3 – 0 – 0 – 4

Course Name: Advance Fluid Mechanics

Course outcome(CO): At the end of the course, the will be able to:

CO-1	Apply the fundamentals of kinematics and conservation laws of fluid flow systems.
CO-2	Apply the principles of high and low Reynolds number flowsto fluid flow systems.
CO-3	Review the concepts of boundary layer and flow in transition.
CO-4	Review the concepts of boundary layer and flow in turbulent
CO-5	Apply Momentum integral technique to turbulent flow conditions

Course Details:

Reynolds transports theorem, Integral and differential forms of mass balance equation, limit of incompressibility.Stress tensor, stress at a point, momentum equation in terms of stress tensor, and LaGrange and Euler description of flow.Construction of rate of strain tensor, Linearity between stress and rate of strain, stokes hypotheses, thermodynamics and hydrostatic pressure.Navier stokes equation in Cartesian , cylindrical and spherical coordinates,special form of navier stocks equations , Initial and boundary conditions.
Exact solution
Definition and examples
Boundary-Layer theory
Prandtl's boundary – layer theory, order of magnitude analysis, derivation of boundary layer equations, origin of separation and turbulence.
Flat plate problem
Momentum integral technique
Turbulance,equilibriumturbulanceboundry layers,Prandtl's mixing length , Moody's diagram ,pipe network calculations

Text Book and References:

1. Agarwal , " Fluid Mechanics & Machinery" , TMH, 2010.
2. Som , S.K. &Biswas,G. " Introduction to Fluid Mechanics &Machins "TMH, 2012.
3. Bansal R.K. "A Text Book Of Fluid Mechanics & Hydraulic Machines" Laxmi Publications (p) Ltd. 2019.
4. Fluid Mechanics & Turbo Machines – M.M.Das, PHI, 2010.

Course Code: MEE-S512 Breakup: 3 – 0 – 0 – 4
Course Name: FLUID MACHINERY

Course outcome(CO): At the end of the course, the will be able to:

CO-1	Understand the basic of impact of liquid jets on surfaces.
CO-2	Understand the working principle of pumps and turbines.
CO-3	Understand the governing of impulse and reaction water turbines.
CO-4	Understand the governing of centrifugal water pumps.
CO-5	Understand the governing of axial water pumps.

Course Details:

UNIT-I
Impact of jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat *&* *c*urve), Effect of inclination of jet with the surface.
Hydraulic Turbines: Classification of turbines, Impulse turbines, Constructional details, Velocity
triangles, Power and efficiency calculations, Governing of Pelton wheel.
UNIT-II
Reaction Turbines: Francis and Kaplan turbines, Constructional details, Velocity triangles, Power
and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.
UNIT-III
Centrifugal Pumps: Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation & separation and their control, Performance characteristics.
UNIT-IV
Positive Displacement Pumps: Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane pumps, Performance characteristics.
UNIT-V
Other Machines: Hydraulic accumulator, Special duty pumps, Intensifier, Hydraulic press, Lift and cranes, Theory of hydraulic coupling and torque converters, Performance characteristics.
Water Lifting Devices: Hydraulic ram, Jet pumps, Air lift pumps.

Text books and Reference:

1. Agarwal , " Fluid Mechanics & Machinery" , TMH, 2010.

2. Som , S.K. &Biswas,G. " Introduction to Fluid Mechanics &Machins "TMH, 2012.
3. Bansal R.K. "A Text Book Of Fluid Mechanics & Hydraulic Machines" Laxmi Publications (p) Ltd. 2019.
4. Fluid Mechanics & Turbo Machines – M.M.Das, PHI, 2010.
5. Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub. 2012