BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(Autonomous Institute affiliated to VTU)

Scheme of Teaching and Examination: Effective from AY 2021 – 22

Choice Based Credit System (CBCS)

UG PROGRAM: MECHANICAL ENGINEERING (ME) | **Semester: IV**

Sl. No	Course Category	Course Code	Course Title	Teaching Dept	Teaching Hours /Week			Credits	Examination			
					L	T	P		Duration	CIE Marks	SEE Marks	Total Marks
1	BS	21MTA41	Numerical Methods, Complex Variable and Sampling Theory	MAT	3	1	1	4	3	50	50	100
2	HS	21KSK42	Samskrutika Kannada	HS	1	0	0	1	1	50	50	100
		21KBK42	Balake Kannada									
		OR										
		21CIP42	Constitution of India and Professional Ethics									
3	UHV	21UHV43	Universal Human Values - II	HS	1	0	0	1	1	50	50	100
4	HS	21HSS44	Environmental Studies	HS	2	0	0	2	2	50	50	100
5	PC	21ME45	Basic Thermodynamics	ME	3	0	0	3	3	50	50	100
6	PC	21ME46	Fluid Mechanics and Machinery	ME	3	0	0	3	3	50	50	100
7	PC	21ME47	Mechanical Measurements and Metrology	ME	3	0	0	3	3	50	50	100
8	PC	21MEL48A	Mechanical Measurements and Metrology Laboratory	ME	0	0	2	1	3	50	50	100
9	PC	21MEL48B	Advanced Part and Surface Modeling Laboratory	ME	0	0	2	1	3	50	50	100
10	PC	21MEL48C	Fluid Mechanics and Machinery Laboratory	ME	0	0	2	1	3	50	50	100
				TOTAL	**16**	**1**	**7**	**20**		**500**	**500**	**1000**

Course Prescribed to Lateral Entry Diploma holders admitted to IV Semester B. E.												
11	NCMC	21DIP41A	Diploma Mathematics-II	MAT	3	0	0	0	-	100	-	100

- The Lateral entry students have to undergo Internship-I during the intervening vacation of III and IV semesters.
- The Assessment Pattern for 1/2/3 credit courses shall be done as per the VTU guidelines.
- BS-MTX (X-Variable) Eg: Core branches: ME, CV, EEE, ETE, ECE-**MTA**, Digital branches: CSE, ISE, AIML- **MTB**.
- Diploma Mathematics II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.
- Successful completion of the course Diploma Mathematics-II shall be indicated as satisfactory in the grade card. Non completion of the same shall be indicated as unsatisfactory.

B.E. MECHANICAL ENGINEERING

BACHELOR OF ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - IV

Numerical Methods, Complex Variable and Sampling Theory – IV (3:1:1) 4

(Common to ECE, ETE, EEE, MECH & CIVIL Branches)

(Effective from the academic year 2021-22)

Course Code	21MTA41	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:1:1	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Apply the concept of Numerical Techniques, probability distribution and stochastic processes to analyze problems arising in Science and Engineering field.
2. Analyze engineering problems by applying the concept of Complex Analysis, Curve fitting and Statistical Methods.
3. Apply the important analytical tools for solving partial differential equations arising in engineering applications.

Module – I

Introduction: Understanding the importance of the study of Complex Analysis, Transformations, Numerical techniques, Statistics, Probability and Sampling Distributions and their applications in the field of Science, Engineering, Business & Research.

Numerical Methods: Numerical solution of algebraic and transcendental equations by Regula Falsi method and Newton Raphson method.

Numerical solution of ordinary differential equations of first order and first degree, Taylor's series method, Modified Euler's method, 4th order Runge -Kutta method, Milne's predictor and corrector methods.

Self-Learning Component: Picard's method

Lab Session 1:

1. Solution of differential equation using Euler Method, 4th order Runge- Kutta method.
2. Determination of roots of a polynomial by Newton Raphson method, Regula Falsi method. (10 Hours)

Module – II

Complex Variables: Analytic functions - Cauchy-Riemann equations in Cartesian and Polar forms, Construction of analytic functions by Milne's method. Complex line integrals - Cauchy's theorem and Cauchy's integral formula.

Transformation: Conformal transformation, discussion of transformations: $w = z^2, w = e^z$, $w = z + \frac{1}{z}$ $(z \neq 0)$. Bilinear transformation-problems.

Self-Learning Component: Residue, poles, Cauchy's Residue theorem (without proof) and problems.

Lab Session 2:

1. Conformal mapping using Matlab for $W = e^z, W = z^2$, $W = z + \frac{1}{z}$ $(z \neq 0)$, complex valued functions.

2. Compute residues and poles for complex functions. (10 Hours)

Module – III

Partial Differential Equations: Formation of PDEs by elimination of arbitrary constants / functions, Solution of non-homogeneous PDE by direct integration, Homogeneous PDEs involving derivative with respect to one independent variable only, Solution of Lagrange's linear PDE. Solution of One-dimensional heat and wave equations by method of separation of variables.
Self-Learning Component: Derivation of One-dimensional heat and wave equations by method of separation of variables.

Lab Session 3:

1. Formation of PDE by eliminating arbitrary constant and function.
2. Solution of Heat equation. (10 Hours)

Module – IV

Vector Integration: Line integrals – problems, Surface and Volume integrals - definition, Green's theorem in a plane, Stoke's theorem and Gauss Divergence theorem (without proof) - problems.
Self-Learning Component: Proof of Green's theorem in a plane.

Lab Session 4:

1. Evaluation of line integral.
2. Evaluate Green's Theorem in a plane. (10 Hours)

Module – V

Sampling Theory: Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, confidence limits for means, student's t-distribution & Chi-square distribution as a test of goodness of fit.
Stochastic process: Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, problems.
Self-Learning Component: Test of hypothesis for difference of means and difference of Proportions.

Lab Session 5:

1. Testing of hypothesis using Chi-square distribution.
2. Testing of hypothesis using t – distribution.

Recap/Summary of the Course. (10 Hours)

Course Outcomes:

The students will be able to:

CO1: Solve order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
CO2: Explain the concepts of analytic functions, describe conformal and Bilinear transformation arising in field theory and signal processing.
CO3: Analyze a variety of partial differential equations and solution by exact methods/method of separation of variables.
CO4: Apply Green's Theorem, Divergence Theorem and Stoke's theorem in various applications in the field of electro-magnetic and gravitational fields and fluid flow problems.

CO5: Demonstrate testing of hypothesis of sampling distributions and illustrate examples of Markov chains related to discrete parameter stochastic process.

Question paper pattern:

SEE will be conducted for 100 marks.

- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.

CIE will be announced prior to the commencement of the course.

- 25 marks for test. Average of three tests will be taken.
- 25 marks for Alternate Assessment Method.

Textbooks:

1. B.S. Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2015.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2015.
3. B.V. Ramana, "Higher Engineering Mathematics", 6th Edition, Tata McGraw-Hill, 2010.

References:

1. N.P. Bali, Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publishers, 2014.
2. H.K. Dass, Er. RajnishVerma, "Higher Engineering Mathematics", 3rd Edition, S. Chand publishers, 2014.
3. P. Kandasamy, K. Thilagavathi, K. Gunavathi, "Engineering Mathematics", Vol. III, 2001.
4. S.S. Sastry, "Introductory Methods of Numerical Analysis", 4th Edition, Prentice Hall of India, 2010.

B.E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – IV

Constitution of India and Professional Ethics (1:0:0) 1
(Common to all Branches)
(Effective from the academic year 2021-2022)

Course Code	21CIP32/42	CIE Marks	50
Teaching Hours/Week (L:T:P)	1-0-0	SEE Marks	50
Total Number of Lecture Hours	13	Exam Hours	01

Course objectives:

This course will enable students to

1. Familiarize with the Indian Constitution and have legal knowledge enabling them to take competitive exams and understand complex political issues.
2. Understand engineering ethics and responsibility and raise awareness and consciousness of the issues related to the profession, liability, risk and safety at work place.

Module – 1

Preamble: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation.

Introduction and Basic information about the Indian Constitution:

Introduction, Definition and significance of the Indian Constitution, Historical Background of the Indian Constitution. Framing of the Indian constitution: Role of the Constituent Assembly, Preamble and Salient features of the Constitution of India.

(2 Hours)

Module – 2

Fundamental Rights, Directive Principles of State Policy and Fundamental Duties: Fundamental Rights and its limitations, Directive Principles of State Policy: Importance and its relevance. Fundamental Duties and their significance. Case Studies

(3 Hours)

Module – 3

Union Administration:

The Union Executive-The President and The Vice President, The Prime Minister and The Council of Ministers, The Union Legislature -Lok Sabha & Rajya Sabha, The Union Judiciary- The Supreme Court of India and its jurisdiction.

(3 Hours)

Module – 4

State Administration, Elections, Constitutional Amendments, Emergency Provisions and Special Constitutional Provisions:

The State Executive-The Governors, The Chief Ministers and The Council of Ministers, The State Legislature-Legislative Assembly and Legislative Council, The State Judiciary- The State High Courts and its jurisdiction.

Elections-Electoral Process in India, Election Commission of India: Powers & Functions, Constitutional Amendments- methods and Important Constitutional Amendments ie 42nd, 44th, 61st,74th, 76th, 77th, 86th ,91st, 100, 101st, 118th , Emergency Provisions-types and its effect, Special Constitutional Provisions for Schedule Castes, Schedule Tribes & Other Backward Classes Women & Children.

(3 Hours)

Module – 5

Professional Ethics:

Definition of Ethics, Scope and Aim of Professional and Engineering Ethics, Code of ethics as defined in the Institution of Engineers (India), Responsibilities of Engineers and impediments to responsibilities, Honesty, Integrity and Reliability of Engineers, Risk, Safety and Liability in Engineering, Case Studies.

(2 Hours)

Course outcomes: The students will be able to:

CO1. Understand and have constitutional knowledge and legal literacy

CO2. Understand Engineering and Professional ethics and responsibilities of Engineers.

Question paper pattern:

- SEE will be conducted for 100 marks. The same will be reduced to 50 Marks.
- There shall be 100 MCQs, each carrying 1 mark
- CIE will be announced prior to the commencement of the course.50 marks for test. Average of three tests will be taken and reduced to 25.

Textbooks

1. Durga Das Basu, Introduction to the Constitution of India, Lexis Nexis, 20th Edn, 2011.

2. Shubham Singles, Charles E. Haries and Et al, Constitution of India and Professional Ethics, Cengage Learning India Private Limited, Latest Edition, 2018.

References

1. M.Govindarajan, S.Natarajan, V.S.Senthilkumar, Engineering Ethics, Prentice –Hall of India Pvt. Ltd. New Delhi, 2004.

2. M.V.Pylee, An Introduction to Constitution of India, Vikas Publishing,2002.

B.E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – IV

Universal Human Values- II (1:0:0) 1
(Effective from the academic year 2021-2022)

Course Code	21UHV43	CIE Marks	50
Teaching Hours/Week (L: T:P)	1-0-0	SEE Marks	50
Total Number of Lecture Hours	13	Exam Hours	01

Course objectives:
This introductory course is intended to

1. Develop a holistic perspective based on self-exploration about family, society and nature/existence.
2. Understand harmony in the family, society and nature/existence
3. Strengthening of self-reflection.
4. Develop commitment and courage to act.

Module – 1

Preamble: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation.

Harmony in the Family: Understanding values in human relationships; Family as basic unit; Harmony in family, Recognizing feelings in relationships-trust, respect, affection, care, guidance, reverence, glory, gratitude and love.
Case study and Group Discussion (3 Hours)

Module – 2

Harmony in Society: Extending relationship from family to society; Comprehensive human goal, Five dimensions of human endeavor; Harmony from family order to World family order.
Case study and Group Discussion

(2 Hours)

Module – 3

Harmony in the Nature: Understanding the harmony in the Nature; Interconnectedness, self- regulation and mutual fulfillment; four orders of nature; Recyclability, Natural characteristics.
Case study and Group Discussion

(3 Hours)

Module – 4

Harmony in Existence: Understanding existence as co-existence; Space; Co-existence of units in space, various attributes of units and space, Role of a human being in existence.
Case study and Group Discussion

(2 Hours)

Module – 5

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values; Definitiveness of Ethical Human Conduct; Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics, Holistic Technologies.

Typical Case Studies, Strategies for Transition towards Value-based Life and Profession Case study and Group Discussion

(3 Hours)

Course outcomes: The students will be able to:

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

Question paper pattern:

- SEE will be conducted for 100 marks. The same will be reduced to 50 Marks.
- There shall be 100 MCQs, each carrying 1 mark.
- CIE will be announced prior to the commencement of the course.
- 50 marks for test. Average of three tests will be taken and reduced to 25.
- 25 marks for Alternate Assessment Method.

Textbooks

1. The Textbook *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN978-93-87034-47-1

2. The Teacher's Manual for *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, NewDelhi, 2019. ISBN 978-93-87034-53-2

References

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher, 1973, Blond & Briggs, UK
4. Vivekananda - Romain Rolland (English)

Relevant websites, documentaries

1. Value Education websites, http://uhv.ac.in,
2. Story of Stuff, *http://www.storyofstuff.com*

B.E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – IV

Environmental Studies (2:0:0) 2
(Common to all Branches)
(Effective from the academic year 2021-22)

Course Code	21HSS44	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:0:0	SEE Marks	50
Total Number of Contact Hours	26	Exam Hours	02

Course Objectives:

This course will enable students to:

1. Recognize the ecological basis for regional and global Environmental issues, and lead by example as an environmental steward.
2. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
3. Analyze the trans-national character of environmental problems and ways of addressing them, including interactions across local to global scales.
4. Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as environmentalists.

Module – 1

Introduction: Relevance of the Subject to Historical and real-time Global, Economic and Societal Scenario. Internship and Job Opportunities in the current scenario.

Ecosystems (Structure and Function): Forest, Desert, Wetlands, Riverine, Oceanic and Lake.
Biodiversity: Types, Value; Hot-spots; Threats to Biodiversity.

*Field work: Visit to a local area to document environmental assets: river / forest / grassland / hill

(5 Hours)

Module – 2

Environmental Pollution & Abatement (with Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.

*Field work: Visit to a local polluted Site-Urban/Rural/Industrial/Agricultural, so as to observe and document environmental pollution and recommend remedial measures.

(5 Hours)

Module – 3

Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

(5 Hours)

*Field work: Visit to a local polluted Site-Urban/Rural/Industrial/Agricultural, so as to observe and document environmental impacts and recommend remedial measures.

Module – 4

Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Fluoride problem in drinking water; Cloud Seeding, and Carbon Trading.

(5 Hours)

*Field work: Visit to a Green Building, followed by understanding of process and its brief documentation.

Module – 5

Latest Developments in Environmental Pollution Mitigation (Concept and Applications): G.I.S. and Remote Sensing, Environment Impact Assessment (E.I.A.), Environmental Management Systems (E.M.S.), ISO14001.

Case Studies: Environmental Stewardship, Environmental NGOs.

*Field work: Visit to an Environmental Engineering Laboratory / Water Treatment Plant/Wastewater treatment Plant, followed by understanding of process and its brief documentation

Summary of the Course

(6 Hours)

(*Note: Any 1 among the 5 Field works is mandatory from the Exercises discussed in across the 5 modules, and Students have to submit a report)

Course outcomes:
The students will be able to:

CO1: Appraise the significance of ecological systems under the ambit of environment.
CO2: Analyze for the consequences owing from anthropogenic interactions on the environmental processes.
CO3: Recommend solutions in the Anthropocene Epoch, with an in-depth understanding of the interdisciplinary facets of environmental issues.
CO4: Elucidate the trans-national character of environmental problems and ways of addressing them.
CO5: Appraise latest developments, concerns and ethical challenges associated with Environmental Protection.

Teaching Practice:

- Classroom teaching (Chalk and Talk)
- ICT – Power Point Presentation
- Audio & Video Visualization Tools

- Case Studies: Real-life Article Inferential Discussion
- Site-visit and Reporting

Question paper pattern:

- SEE will be conducted for 100 marks. The same will be reduced to 50 Marks.
- There shall be 100 MCQs, each carrying 1 mark.
- CIE will be announced prior to the commencement of the course.
- 50 marks for test. Average of three tests will be taken and reduced to 25.
- 25 marks for Alternate Assessment Method.

Alternate Assessment Methods:

→ Any ONE Alternate Assessment Tool (AAT) from COE suggested list.

Text Books

1. Rajesh Gopinath and N. Balasubramanya, "Environmental science and Engineering", 1st Edition, City of Publisher, Cengage Learning India Private Limited, 2018.
2. J. S. Singh, S. P. Singh and S. R. Gupta, "Ecology, Environmental Science and Conservation", India, S. Chand Publishing, 2017.

References:

1. M. Gadgil and R. Guha, "This Fissured Land: An Ecological History of India", Univ. of California Press, 1993.
2. E. P. Odum and H. T. Odum, "Fundamentals of Ecology", Philadelphia: Saunders Publisher, 1971.
3. M. L. Mckinney, "Environmental Science systems & Solutions", Web enhanced Edition, City of Publisher, R. M. Publisher, 1996.

B.E. MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – IV

Basic Thermodynamics (3:0:0)3

(Effective from the academic year 2021-22)

Course Code	21ME45	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:

1. Learn about thermodynamic system and its equilibrium.
2. Understand various forms of energy - heat transfer and work.
3. Study the basic laws of thermodynamics including, zeroth law, first law and second law.
4. Understand the principle of entropy, pure substance, psychometry and air conditioning systems.

Module –1

Preamble: Significance and scope of thermodynamics, concepts of thermodynamics in economic growth, emerging trends in thermodynamics.

Fundamentals of Thermodynamics: Macroscopic and microscopic view point, thermodynamic systems, thermodynamic properties, processes and cycles, homogeneous and heterogeneous system, thermodynamic equilibrium, quasi static process, zeroth law of thermodynamics, temperature, scales, International practical temperature scale, numericals.

Work and Heat: Work transfer, P-dV work, other types of work transfer, net work done by a system, heat transfer – A path function, specific heat and latent heat, comparison of work and heat transfer, numericals.

(09 Hours)

Self Study Component: Various temperature measuring devices.

Module – 2

First Law of Thermodynamics: First law for a closed system undergoing a cycle and change of state, internal energy is property of the system, Perpetual Motion Machine of 1st kind – PMM1, numericals.

First Law applied to flow processes: Control volume, steady state and steady flow**, S**teady Flow Energy Equation (SFEE), applications of SFEE related to turbines, compressors, nozzles, throttling device and heat exchangers, numericals on SFEE.

(08 Hours)

Self Study Component: Different forms of stored energy.

Module – 3

Second Law of Thermodynamics: Cyclic heat engine, energy reservoirs, Kelvin – Planck statement and Clausius statement of second law of thermodynamics, refrigerator and heat pump, equivalence of Kelvin-Planck and Clausius statements of second law of thermodynamics, Perpetual Motion Machine of 2nd kind – PMM2, reversibility and irreversibility, causes of irreversibility, Carnot cycle, reversed heat engine, Carnot's theorem, absolute thermodynamics temperature scale, efficiency of the reversible heat engine, numericals.

(08 Hours)

Self Study Component: Applications of heat pump with reference to space heating, water heating and heat recovery systems.

Module – 4

Entropy: Introduction, Clausius theorem for reversible cycle, property of entropy, entropy principle, inequality of Clausius, entropy change in an irreversible process, numericals.

Pure Substances: Two property rule, triple point, critical point, phase equilibrium diagrams: P-V, P-T, and T-S diagrams, steam tables and its use, dryness fraction, separating calorimeter, throttling calorimeter, combined separating and throttling calorimeter, numericals.

(08 Hours)

Self Study Component: Physical significance of entropy and its implications in mechanical engineering.

Module – 5

Psychometrics and Air-conditioning Systems: Psychometric properties of air, psychometric chart, analyzing air-conditioning processes: heating, cooling, dehumidification and humidification, evaporative cooling, adiabatic mixing of two moist air streams. cooling towers, numericals.

Recap / Summary of the course.

(07 Hours)

Self Study Component: Applications of air conditioning for human comfort.

Course outcomes:

The students will be able to:

CO1: Describe the fundamental concepts of thermodynamics for energy interaction systems.
CO2: Apply the principles of thermodynamics for the real world applications.
CO3: Analyze the laws of thermodynamics to enhance the performance of thermodynamic systems.

Assessment Methods:

I. Continuous Internal Evaluation (CIE): 50 Marks

- **Three Internal Assessments** conducted for 50 Marks each and reduced to 25 Marks. Average of three Internal Assessments will be considered for 25 Marks.
- **Alternative Assessment** will be conducted for 25 Marks using appropriate tools.

II. Semester End Examination (SEE): 50 Marks

- SEE is conducted for 100 Marks and reduced to 50 Marks.

Question Paper Pattern

Part - A: Comprises 20 objective type questions carrying 1 Marks each with a total 20 Marks.

Part - B: Comprises 10 descriptive type questions carrying 16 Marks each. Each Module will have two questions with an internal choice to answer any one full question. There will be a maximum of three sub section for each question.

TEXT BOOKS:

1. R.K. Rajput, "Engineering Thermodynamics", 6th Edition, Laxmi Publications, 2017.

2. P.K. Nag, “Basic and Applied Thermodynamics”, 6th Edition, Tata McGraw Hill, 2015.

REFERENCES:

1. A. Venkatesh, 2008, “Basic Engineering Thermodynamics”, 1st Edition, Universities Press, 2008.
2. Yunus A. Cenegal., Michael A. Boles, “Thermodynamics- An Engineering Approach”, 7th Edition, Tata McGraw Hill publications, 2001.
3. James B Jones, G.A. Hawkins, “Engineering Thermodynamics – An introductory textbook”, 2nd Edition, John Wiley Sons, 2010.
4. Y.V.C.Rao, “An Introduction to Thermodynamics”, 2nd Edition, Universities Press, 2004.
5. Richard E Sonntag, Claus Borgnakke, Gordon J Van Wylen, “Fundamentals of Thermodynamics”, 6th Edition, Wiley Eastern, 2002.

B.E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – IV

Fluid Mechanics and Machinery (3:0:0) 3
(Effective from the Year 2021-22)

Course Code	21ME46	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:
1. Understand the basic properties of fluids and their measurement.
2. Equip with the knowledge of hydrostatics and dynamics.
3. Illustrate the flow characteristic and dynamics of flow field for various engineering applications.
4. Analyse the concepts of Energy transfer in hydraulic machines.

Module – 1

Preamble: Relevance of Fluid Mechanics for the development of Science and Technology, its relevance to agriculture.

Fundamentals of Fluid Mechanics: Concept of fluid, fluid as a continuum, properties of fluid viscosity, surface tension, capillarity, bulk modulus and vapor pressure, numericals.

Fluid pressure and its measurement: Pressure and stress at a point, absolute, gauge and vacuum pressure, Pascal's law, measurement of atmospheric and gauge pressure, piezometer. Manometers: U-tube, inclined, differential manometers and Air manometers, numericals.

(08 Hours)

Self Study Component: Bourdon tube and Diaphragm pressure gauge.

Module – 2

Hydrostatic forces on surfaces: Horizontal, vertical and inclined plane surfaces, expression for center of pressure, total pressure, numericals.

Buoyancy and floatation: Buoyancy, buoyant force and center of buoyancy, Archimedes principle, Metacentric height, determination of metacentric height by analytical and experimental methods, conditions of equilibrium for floating and submerged bodies, numericals.

(07 Hours)

Self Study Component: Metacentric height in marine application.

Module – 3

Kinematics of fluid flow: 1D, 2D, 3D flow, steady and unsteady flow, uniform and non-uniform flow, laminar and turbulent flow, compressible and incompressible flow, rotational and irrotational flow, ideal and fluid flow. Lagrangian and Eulerian methods of describing fluid motion. Stream line, streak line and pathline. Derivation of continuity equation in Cartesian coordinates.

Fluid dynamics: Euler's equation of motion, Bernoulli's equation from first principles, practical applications of Bernoulli's theorem – venturimeter, orifice meter and pitot tube, numericals.

Flow through pipes: Major loss due to friction, Darcy Weisbach and Chezy's equation.

(09 Hours)

Self Study Component: Minor losses in flow through pipes.

Module – 4

Fluid Machinery: Classification, parts of turbo machines, dimensional analysis, Dimension less numbers, model studies, unit and specific quantities, numericals.

Energy exchange in Turbo machines: Euler's turbine equation, alternate form of Euler's turbine equation, velocity triangles for different values of degree of reaction, relation between degree of reaction and utilization factor, numericals.

(8 Hours)

Self Study Component: Working of compressors and blowers.

Module – 5

Hydraulic Turbines: Classification, power developed and efficiencies of impulse and reaction turbines - Pelton, Francis and Kaplan turbines, numericals.

Steam Turbines: Classification, need and methods of compounding, condition for maximum blade efficiency for single stage impulse turbine, numericals.

Centrifugal Pump: Classification, working and minimum starting speed.

Recap /Summary of the Course.

(8 Hours)

Self Study Component: Study on various heads of centrifugal pump and minimum suction lift.

Course outcomes:

The students will be able to:

CO1: Describe the concepts of fluid properties, hydrostatics, kinematics & dynamics of fluid, working of fluid machinery and dimensional analysis.

CO2: Apply the knowledge of Bernoulli's equation, principles of Fluid machinery and non-dimensional number for practical applications.

CO3: Analyze the various methods of fluid pressure measurement, conditions of equilibrium of floating bodies, submerged bodies and energy transfer in turbo machines applying dimensional analysis.

Assessment Methods:

I. Continuous Internal Evaluation (CIE): 50 Marks

- **Three Internal Assessments** conducted for 50 Marks each and reduced to 25 Marks. Average of three Internal Assessments will be considered for 25 Marks.
- **Alternative Assessment** will be conducted for 25 Marks using appropriate tools.

II. Semester End Examination (SEE): 50 Marks

- SEE is conducted for 100 Marks and reduced to 50 Marks.

  Question Paper Pattern

  Part - A: Comprises 20 objective type questions carrying 1 Marks each with a total

20 Marks.

Part - B: Comprises 10 descriptive type questions carrying 16 Marks each. Each Module will have two questions with an internal choice to answer any one full question. There will be a maximum of three sub section for each question.

TEXTBOOKS:

1. Dr R.K Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", 10th Edition, Laxmi Publishers, 2019.
2. F M White, "Fluid Mechanics", 8th Edition, McGraw Hill Publications, 2016.

REFERENCES:

1. Yunus A. Cengel John M.Cimbala, "Fluid Mechanics", 3rd Edition. Tata McGraw Hill, 2014.
2. S.M.Yahya"Turbines Compressors and fans",3rd Edition, Tata McGraw Hill, 2017
3. Pijush. K. Kundu, Iram Cochen, "Fluid Mechanics", 3rd Edition, ELSEVIER, 2005.
4. Fox, McDonald, "Introduction to Fluid Mechanics", 8th Edition, John Wiley Publications, 2014.
5. Shankar Nag G L, Keerthi Kumar N, "Turbomachines", 1st Edition, Cengage Publications, 2019.

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER - IV

Mechanical Measurements and Metrology (3:0:0) 3
(Effective from the academic year 2021-22)

Course Code	21ME47	CIE Marks	50
Teaching Hours/Week (L: T:P)	3:0:0	SEE Marks	50
Total Number of lecture hours	40	Exam Hours	03

Course Objectives:

This course will enable students to:

1. Understand the concept of metrology and standards of measurement.
2. Equip with knowledge of limits, fits, tolerances and gauging
3. Acquire knowledge of linear and Angular measurements, Screw thread and gear measurement & comparators.
4. Understand the knowledge of measurement systems and methods with emphasis on different Transducers, intermediate modifying and terminating devices.
5. Understand the measurement of Force, Torque, Pressure, Temperature and Strain.

Module-1

Preamble: Introduction, significance and scope of standards and measurement techniques in industries.

Metrology and Measurement System: Objectives and classification of metrology, standards of length, wave length standard, sub division of standards, Abbe's Principle, numericals on length calibration.
Line and End standards, slip gauges, wringing phenomena. Angular measurements: Bevel protractor, sine bar, angle gauges, numericals on building of slip gauges using M87 & M112 sets and angle gauges.
Generalized measurement system, mechanical loading, static and dynamic characteristics of instruments.

(09 Hours)

Self Study Component: Factors considered in selection of instruments, errors and its classification, sources of errors.

Module-2

Systems of Limits, Fits, Tolerance and Gauging: Types of tolerances, tolerance specification in assembly, limits of size, Indian standards, cost and tolerances, compound tolerances, accumulation of tolerances. Geometric and Position Tolerances, Fits: Types and designation, hole and shaft basis system, numericals on tolerances and fits. Classification of gauges. Types of Limit gauges- plain plug gauges, ring gauges, snap gauges. Taylor's principle, design of GO and NO-GO gauges, wear allowance on gauges, numericals on design of gauges.

Comparators: Functional requirements, classification, mechanical- Johnson Mikrokator, sigma comparators, dial indicator, electrical- Linear Variable Differential Transformer (LVDT), Pneumatic- back pressure gauges, solex comparators and optical comparators- Zeiss ultraoptimeter.

(08 Hours)

Self Study Component: Principle of interchangeability and selective assembly.

Module-3

Measurement of screw thread: Terminology of screw threads, measurement of major

diameter, minor diameter, pitch and angle. Effective diameter measurement by 2 wire and 3 wire methods, best size wire. Screw thread gauges, Toolmaker's microscope, Profile projector.

Gear tooth Measurements: Terminology of gear, tooth thickness measurement using constant chord method, measurement of pitch, concentricity, run out and involute profile. Gear roll tester for composite error.

Coordinate Measuring Machines (CMM): Constructional features and applications.

(07 Hours)

Self Study Component: Basic concepts, advantages, types and applications of lasers, laser interferometers.

Module-4

Transducers, Intermediate and Terminating devices: Transducers, transfer efficiency, primary and secondary transducers, mechanical, electrical, electronic transducers and their advantages. Intermediate modifying devices, mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers. Terminating devices, cathode ray oscilloscope, oscillographs.

Measurement of Force, Torque and Pressure: Working principle of analytical and platform balance, proving ring, Prony brake and hydraulic dynamometers, Pirani gauge, Mcleod gauge, Bridgeman gauge.

(07 Hours)

Self Study Component: Load cell, Dead weight pressure gauge and Eddy current dynamometers

Module-5

Measurement of strain and temperature: Theory of strain gauges, types, electrical resistance strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement. Temperature Compensation, Wheatstone bridge circuit, orientation of strain gauges for force and torque. Resistance thermometers, thermocouple and materials used for construction, laws of thermocouple, pyrometer, optical pyrometer.

Measurement of Motion: Elementary vibrometers and vibration detectors**,** Elementary accelerometers and seismic instrument.

Recap/ Summary of the course.

(09 Hours)

Self Study Component: Proximity sensors and its types, vibration sensors, torque sensors.

Course Outcomes:

The student will be able to:

CO1: Illustrate the principle of CMM and various devices for measuring torque, force, pressure, strain and temperature.

CO2: Apply the scientific principles involved in length and angular measurements.

CO3: Design limit gauges for inspection purpose.

Assessment Methods:

I. Continuous Internal Evaluation (CIE): 50 Marks

- **Three Internal Assessments** conducted for 50 Marks each and reduced to 25 Marks. Average of three Internal Assessments will be considered for 25 Marks.
- **Alternative Assessment** will be conducted for 25 Marks using appropriate tools.

II. Semester End Examination (SEE): 50 Marks

- SEE is conducted for 100 Marks and reduced to 50 Marks.

Question Paper Pattern

Part -A: Comprises 20 objective type questions carrying 1 Marks each with a total 20 Marks.

Part -B: Comprises 10 descriptive type questions carrying 16 Marks each. Each Module will have two questions with an internal choice to answer any one full question. There will be a maximum of three sub section for each question.

TEXT BOOKS:

1. R. K Jain, "Engineering Metrology", 20th Edition, Khanna Publishers, 2008.
2. Beckwith Marangoni and Leinhard, "Mechanical Measurements", 6th Edition, Pearson Education, 2006.

REFERENCES:

1. N.V. Raghavendra and L. Krishnamurthy, "Engineering Metrology and Measurements", Oxford University Press, 2013.
2. Gupta I.C, "Engineering Metrology", 7th Edition, Dhanpat Rai Publications, 2018.
3. Ernest O. Doebelin, "Measurement Systems, Applications & Design", 4th Edition, McGraw–Hill, 1990.
4. Er. R K Rajput, "Mechanical Measurements and Instrumentation", 2nd Edition, S K Kataria & Sons Publications, 2012.
5. Alan S Morris, "Measurement and Instrumentation Principles", 3rd Edition, Butterworth, 2006.

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER - IV

Mechanical Measurements and Metrology Laboratory (0:0:1)1
(Effective from the academic year 2021-22)

Course Code	21MEL48A	CIE Marks	50
Teaching Hours/Week (L: T:P)	0:0:2	SEE Marks	50
Total Number of Contact hours	26	Exam Hours	03

Course Objectives:

This course will enable students to:

1. Illustrate the theoretical concepts taught in Metrology & Instrumentation lab through experiments.
2. Illustrate the use of various measuring tools & measuring techniques.
3. Understand calibration techniques of various measuring devices.

Part –A

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.

Part –B

1. Calibration of Micrometer and Vernier Caliper using slip gauges.
2. Measurement of angle using bevel protractor, Sine bar and Sine Centre
3. Measurement of gear tooth profile using gear tooth Vernier and Gear tooth micrometer.
4. Measurements using Optical Projector and Tool makers' Microscope.
5. Measurements of Screw thread parameter using two wire or three-wire methods.
6. Measurement of alignment using Autocollimator and Roller set.
7. Measurement of cutting tool forces using Lathe tool and drill tool dynamometer.
8. Measurements of surface roughness using Tally Surf.
9. Verification of dimensions and geometry of given components using mechanical comparator.
10. Measurement of surface flatness using Optical Flats.

Course Outcomes:

The student will be able to:

CO1: Select suitable instruments for length and angular measurements.
CO2: Apply the scientific principles and methods for different measuring systems.
CO3: Analyse different parameters involved in different mechanical components and machines.

Assessment methods:

I. Continuous Internal Evaluation (CIE): 50 Marks

The marks for the record write-up and internal assessment will be in the ratio of 60:40. Record will be continuously evaluated for each experiment with regard to conduction, write-up and viva-voce: 30Marks.
Internal Test will be conducted for 100 Marks and reduced to 20 Marks.

II. Semester End Examination (SEE): 50 Marks

- SEE is conducted for 100 Marks and reduced to 50 Marks.

Question paper pattern:

One question from Part-A : 30 Marks
One question from Part-B : 50 Marks
Viva – Voce : 20 Marks
TOTAL : 100 Marks

B.E. MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – IV

Advanced Part and Surface Modeling Laboratory (0:0:1) 1

(Effective from the academic year 2021-22)

Course Code	21MEL48B	CIE Marks	50
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	50
Total Number of Contact Hours	26	Exam Hours	03

Course objectives:

This course will enable students to:

1. Visualize various types of curves through 3D sketching, there by develop complex part models.
2. Interpret the Sheet Metal drawings and identify the punching, bending and cutting operation required for sheet metal part.
3. Expose themselves for surface modelling to develop containers, automotive and aircraft body parts.

Part – A

Complex part modelling:

1. Create complex solid parts using following features:
    a. Combine
    b. Split
    c. Indent
    d. Flex
    e. 3D Sweep

Sheet metal working:

2. Create 3D sheet metal models for given dimension and generate 2D manufacturing drawings for the following:
    a. Panel Board
    b. Battery Cabinet
    c. CPU Cabinet

Part – B

Surface Modeling for container and casing:

1. Model a liquid container to carry a specific volume of shampoo/cocking oil
2. Create the cover of a hair-dryer for the given dimensions
3. Create the computer mouse for the given dimensions

Surface Modeling for Automotive/Aeronautical applications (only for practice):

4. Develop 3D surface modelling of a vehicle using the sketches provided
5. Develop 3D surface modelling of an aircraft wing using standard NACA curves

Course outcomes:

The students will be able to:

CO1: Construct manufacturing drawings for complex machine parts.

CO2: Create sheet metal products for given applications.

CO3: Develop 3D surface modeling to generate container/casing/automotive and aircraft parts.

Assessment methods:

I. Continuous Internal Evaluation (CIE): 50 Marks

- Sketchbook drawing and Printouts of CAD for the exercises given will carry 30 Marks.
- An Internal Assessments will be conducted for 60 Marks and reduced to 20 Marks.

II. Semester End Examination (SEE): 50 Marks

- SEE is conducted for 100 Marks and reduced to 50 Marks.

Question paper pattern:

One question from Part-A : 40 Marks
One question from Part-B : 60 Marks
TOTAL : 100 Marks

B.E. MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – IV

Fluid Mechanics and Machinery Laboratory (0:0:2) 1

(Effective from the academic year 2021-22)

Course Code	21MEL48C	CIE Marks	50
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	50
Total Number of Contact Hours	26	Exam Hours	03

Course objectives:

This course will enable students to:

1. Understand the flow measurements using various types of flow measuring devices.
2. Know the energy conversion principles associated with hydraulic turbines and pumps.
3. Measure the major and minor losses as applied to flow of fluids through the pipes.
4. Analyze the performance of fluid machines.

Part – A

1. Determination of major losses in flow through pipes.
2. Determination of minor losses in flow through pipes.
3. Determination of impact of jet on flat, inclined, and curved vanes.
4. Determination of total head using Bernoulli's theorem apparatus.
5. Determination of coefficient of discharge through:
    a. Orifice meter.
    b. Venturimeter.
    c. Nozzle.
    d. V-Notch.

Part – B

1. To determine the overall efficiency and also to draw the main characteristic curves and operating characteristic curves at different load and speed for the following hydraulic turbines:
    a. Pelton wheel.
    b. Francis turbine.
    c. Kaplan turbine.
2. To determine the overall efficiency of the following hydraulic pumps:
    a. Centrifugal pump.
    b. Reciprocating pump.
3. To determine of mechanical efficiency and volumetric efficiency of two stage reciprocating air compressor.
4. To determine the efficiency of an air blower.

Course outcomes:

The students will be able to:

CO1: Apply the Bernoulli's equation to measure the flow rates in pipes and notches.

CO2: Analyze major and minor losses of fluids flowing through pipes.

CO3: Evaluate the performance characteristics of fluid machineries.

Assessment methods:

I. Continuous Internal Evaluation (CIE): 50 Marks

- The marks for the record write-up and internal assessment will be in the ratio of 60:40. Record will be continuously evaluated for each experiment with regard to conduction, write-up and viva-voce: 30Marks.
- Internal Test will be conducted for 100 Marks and reduced to 20 Marks.

II. Semester End Examination (SEE): 50 Marks

- SEE is conducted for 100 Marks and reduced to 50 Marks.

Question paper pattern:

One question from Part-A : 30 Marks
One question from Part-B : 50 Marks
Viva – Voce : 20 Marks
Total **: 100 Marks**

B.E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – IV

Diploma Mathematics- II (0:0:0) NIL
COMMON TO ALL BRANCHES
(Effective from the academic year 2021-22)

Course Code	21DIP41A	CIE Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	-
Total Number of Contact Hours	3	Exam Hours	3

Course Objectives:
This course will enable students to:
1. To provide an insight into linear & higher order ODE's and elementary probability theory.
2. To familiarize the important tools of Laplace transformations required to analyse the engineering problems.

Module – I

Introduction: Understanding the importance of Vector Differentiation, Differential equations, Laplace Transforms and Probability in the field of Science, Engineering, Business and Research.
Differential equations–I: Introduction-solutions of first order and first-degree differential equations: exact, Equations reducible to exact, linear differential equations and Bernoulli's equation. (6 hours)

Module – II

Differential equations–II: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous/non-homogeneous equations. Inverse differential operators. [Particular Integral restricted to $R(x)= e^{ax}$, sin ax, cos ax, polynomial for $f(D)y = R(x)$]. (6 hours)

Module – III

Probability: Introduction to Probability, Sample space and events. Axioms of probability. Addition & multiplication theorems. Conditional probability, Bayes' theorem, problems. (6 hours)

Module – IV

Laplace Transforms: Definition and Laplace transforms of elementary functions, Laplace Transforms of e^{at} f(t), t^nf(t), n is a positive integer & (f(t))/t (without proof), Periodic function (statement only) and Unit-step function – problems. (6 hours)

Module – V

Inverse Laplace Transforms: Inverse Laplace Transform- Definition and problems, Convolution theorem (No Proof), Evaluation of Inverse Laplace Transform using Convolution theorem. Solution of linear differential equations using Laplace transforms technique.
Recap/Summary of the course. (6 hours)

Course outcomes: The students will be able to:
CO1: Solve first and higher order ordinary differential equations.
CO2: Use Laplace transform and inverse Laplace transform in solving differential equation.
CO3: Apply elementary probability theory for related problems.

Question paper pattern:
CIE will be announced prior to the commencement of the course.
- 75 marks for test. Average of three tests will be taken.

- 25 marks for Alternate Assessment Method.

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, 2015.
2. E. Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2015.
3. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill, 2010.

References:

1. N. P. Bali, Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publishers, 2014.
2. C. Pandurangappa, Advanced Mathematics II (Lateral entry bridge course text book)", 3rd Edition. Sanguine Publishers, 2015.
3. S. Pal, S. C. Bhunia, Engineering Mathematics, 3rd Edition, Oxford University Press, 2011.
4. H. K. Dass, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand Private Ltd, 2014.