Academic Program: UG

Academic Year 2026-27

Department of
Mechanical Engineering

III & IV Semester B.E.

Syllabus

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE
OF ENGINEERING & TECHNOLOGY,
DHARWAD – 580 002
(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi
Accredited by NBA under Tier-1
Ph: 0836-2447465 Fax: 0836-2464638 Web: www.sdmcet.ac.in

It is certified that the scheme and syllabus for III & IV semester B.E. in Mechanical Engineering is recommended by the Board of Studies of Mechanical Engineering Department and approved by the Academic Council, SDM College of Engineering &Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2026-27 till further revision.

Chairman BoS & HoD **Principal**

Department of Mechanical Engineering

College Vision and Mission

Vision

To develop competent professionals with human values

Mission

- To have contextually relevant Curricula.
- To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
- To enhance Research Culture
- To involve Industrial Expertise for connecting classroom content to real life situations.
- To inculcate Ethics and impart soft-skill leading to overall Personality Development.

QUALITY POLICY:

In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

CORE VALUES:

Competency

Commitment

Equity

Team work and Trust

DEPARTMENT VISION AND MISSION

Vision:

To establish a synergetic Mechanical Engineering program anchored in fundamentals and relevant state of the art technologies, thereby enabling the students to achieve all round development for careers in industry and for higher learning, being responsible to society and environment.

Mission:

1. To establish a curricula & syllabi consisting of robust core courses with emphasis on imparting fundamental principles of mechanical engineering coupled with adaptive and relevant electives catering to the cutting edge technologies.
2. To promote interactive teaching practices using modern educational tools & techniques to attain synergy in teaching, research and industrial practices.
3. To imbibe industrial expertise for connecting class room learning to real life situation.
4. To impart soft skills and professional ethics enabling students to achieve an all-round personality development, making them responsive to societal needs and environmental concerns.

Programme Educational Objectives (PEOs):

1. Graduates will be successful in industry, research and higher learning.
2. Graduates will formulate, analyze and solve engineering problems.
3. Graduates will work in teams to address industrial and socially relevant problems / projects.
4. Graduates exhibit awareness and commitment to lifelong learning & practice professional ethics.

Program Outcomes (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **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.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

13. **Industrial interactions:** Enhance knowledge of mechanical engineering with industrial practices and standards by exposure to industries.

14. **Role of economics and costing:** Learn the concepts of economics and costing to provide effective solutions to mechanical engineering problems.

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY, DHARWAD
Department of Mechanical Engineering
III Semester
Scheme of Teaching and Examinations 2026-27

Sl. No	Course	Course code	Course Title	TD/PSB	Teaching Hours/Week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	ASC	22UMAC300	Engineering Mathematics-III	Maths	2	2	0	03	50	100	100	3
2	PCC	22UMEC300	Engineering Thermodynamics	ME	4	0	0	03	50	100	100	4
3	PCC	22UMEC301	Materials Science & Engineering	ME	3	0	0	03	50	100	100	3
4	PCC	22UMEC302	Mechanics of Materials	ME	3	0	0	03	50	100	100	3
5	PCCL	22UMEL303	Materials Science & Materials Testing Laboratory	ME	0	0	2	03	50	50	100	1
6	PCCL	22UMEL304	Foundry & Forging Laboratory	ME	0	0	2	03	50	50	100	1
6	ESC	22USMEC305	Machine Drawing	ME	3	0	2	03	50	100	100	3
7	UHV	22UHVK306	Universal Human Values-I	ME	1	0	0	01	50	50	100	1
8	AEC	22UMEE321	Spreadsheet for Engineers	ME	0	0	2	03	50	50	100	1
9	ASC	22UMBA301	Mathematics	Maths	3	0	0	-	50	-	50	Audit
10	MC	22UNSK307	National Service Scheme	NSS	0	0	2	-	50	-	50	Audit
		22UPYK307	Physical Education and Yoga	PE&Y								
								Total			1000	20

ASC: Applied science course, **PCC:** Professional Core Course, **PCCL:** Professional Core Course laboratory, **ESC:** Engineering Science Course, **ETC:** Emerging Technology Course, **PLC:** Programming Language Course, **UHV:** Universal Human Value Course, **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **MC:** Mandatory Course, **L**: Lecture, **T**: Tutorial, **P**: Practical, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **MC:** Mandatory Course. This letter in the course code indicates common to all the stream of engineering. **TD**: Teaching department, **PSB**: Paper Setting Board.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) with the concerned course coordinator during the first week of respective semester. Activities shall be carried

out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.
AICTE activity point: Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the program. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case student fails to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY, DHARWAD

Department of Mechanical Engineering

IV Semester

Scheme of Teaching and Examinations 2026-27

Sl. No	Course	Course code	Course Title	TD/PSB	Teaching Hours/Week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	ASC	22UMAC400	Engineering Mathematics-IV	Maths	2	2	0	03	50	100	100	3
2	PCC	22UMEC400	Design of Machine Elements	ME	2	2	0	03	50	100	100	3
3	PCC	22UMEC401	Manufacturing Processes	ME	3	0	0	03	50	100	100	3
4	PCC	22UMEC402	Fluid Mechanics	ME	2	2	0	03	50	100	100	3
5	PCCL	22UMEL403	Metrology and Measurements Laboratory	ME	0	0	2	03	50	50	100	1
6	PCCL	22UMEL404	Thermal Engineering Laboratory-I	ME	0	0	2	03	50	50	100	1
7	ESC	22USMEC405	Metrology and Measurements	ME	2	2	0	03	50	100	100	3
8	UHV	22UHVK406	Universal Human Values-II	ME	1	0	0	01	50	50	100	1
9	AEC	22UMEE421	Electro-Mechanical Systems with IOT	ME	0	0	2	03	50	50	100	1
10	MC	22UBEK407	Biology for Engineers	ME	1	0	0	01	50	50	50	1
11	ASC	22UMBA401	Mathematics	Maths	3	0	0	-	50	-	50	Audit
12	MC	22UNSK408	National Service Scheme	NSS	0	0	2	-	50	-	50	Audit
		22UPYK408	Physical Education and Yoga	PE&Y								
								Total			1100	20

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III Semester

22UMAC300	Engineering Mathematics-III	(2- 2 - 0)3

Contact Hours:39

Course Learning Objectives (CLOs):

To have an insight into Fourier series, Fourier transforms, Z-transforms. To solve linear and Non-linear programming problems and use statistical tools to problems arising in engineering applications using numerical methods.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Express** periodic function as a Fourier series and obtain the various harmonics of the Fourier series expansion for the given numerical data.	-	-	1,2
CO-2	**Transform** the given function using Fourier transforms depending on the nature of engineering applications. **Apply** Z-transform for series of mathematical conversion to mathematical framework used as digital filter. **Solve** difference equations using Z-transform.	-	-	1,2
CO-3	**Obtain** series solution of ordinary differential equations.	-	-	1,2
CO-4	**Make** use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.	-	1,2,12	-
CO-5	**Formulate** LPP and **obtain** optimal solutions using different tools.	-	1,2,12	-

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.4	1.4	-	-	-	-	-	-	-	-	-	2

Pre-requisites: Knowledge of fundamentals of calculus, Statistical averages

Course Contents:

Unit-1

Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions of period 2π and arbitrary period. Half- range Fourier series. Practical harmonic analysis, examples from engineering field. **8 Hrs.**

Unit-2

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. (Simple problems).

Z-Transforms and Difference Equations: Z-transform- definition, Standard Z-transforms, Damping and shifting rules, Initial value, and Final value theorems (without proof) problems. Inverse Z-transform. Simple problems. Difference equations-basic definition. Application of Z-transform to solve Difference equations. **9Hrs.**

. **Unit-3**

Special functions: Series solution of Bessel's differential equation leading to $J_n(x)$-Bessel's function of first kind, Recurrence relations, Generating function of Bessel's functions, orthogonality of Bessel's function. **8Hrs.**

Unit-4

Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form $= \boldsymbol{ax + b}; \boldsymbol{y = ax^2 + bx + c}; \boldsymbol{y = ax^b}$..

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation -problems. Regression analysis- lines of regression–problems. **7 Hrs.**

Unit-V

Linear and Non-Linear programming: Introduction, Mathematical formulation of a L.P.P, basic solution. Geometric (or graphical) method, Simplex method.

Non Linear Programming – Constrained extremal problems-Lagrange's multiplier method. **7 Hrs.**

Reference Books:

1. **B.S.Grewal**: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
2. **E.Kreyszig**: Advanced Engineering Mathematics, John Wiley &Sons, 10th Ed.(Reprint).2016.
3. **Srimanta Pal et al**: Engineering Mathematics, Oxford University Press,
4. 3rd Edition, 2016.
5. **B. V. Ramana**:"HigherEngineering Mathematics" 11th Edition, Tata McGraw- Hill, 2010.
6. **Er.Prem Kumar Gupta, Dr.D.S.Hira,** “Operation Research “ S.Chand & Company Pvt.Ltd. 7th edition, 2014.

22UMEC300	Engineering Thermodynamics	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn, fundamental concepts of thermodynamics, through laws of thermodynamics and applications to analysis of vapor and gas power cycles

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Apply zeroth law and first law of thermodynamics to closed and open systems for work and heat interactions	1,2	-	3
CO-2	Apply Second law of thermodynamics to closed and open systems for availability and exergy	1,2	-	3
CO-3	Explain the behavior of ideal and real gases in combustion.	-	1,2	3
CO-4	Determine performance of vapor power cycles with pure substances as a working medium.	-	1,2	-
CO-5	Determine the performance of gas power cycles and its application to gas turbine cycles	-	1,2	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.4	2.4	1	-	-	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Unit - I

Introduction and Review of fundamental concepts of thermodynamics: Zeroth law of thermodynamics. Temperature; scales, thermometry, Design of Thermometers.

Work and Heat: Thermodynamic definition of work, Displacement work as a part of a system boundary and Expressions for thermodynamic processes. Other types of work and Heat.

First Law of Thermodynamics: Statement, apply First law to non - cyclic and cyclic processes. Internal Energy as a property, Steady Flow Energy Equation (SFEE) and its engineering applications. **12 Hrs**

Unit - II

Second Law of Thermodynamics and Entropy: Limitations of first law of thermodynamics. Devices converting heat to work; (a) In a thermodynamic cycle, (b) In a mechanical cycle. Thermal reservoir, direct heat engine; schematic representation and efficiency. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Carnot cycle, Clausius inequality, Statement-proof, Entropy- definition, a property, change of entropy, entropy as a quantitative test for irreversibility.

Available energy and Exergy: Available energy, Maximum work in a reversible process; useful work; Dead state; availability.

10 Hrs

Unit - III

Introduction and Review of Ideal and Real gases: Ideal gas mixtures, Daltons law of partial pressures, Amagat's law of additive volumes,

Thermodynamic relations: Maxwell's equations and TdS equation**.**

Combustion thermodynamics: Theoretical (Stoichiometric) air for combustion of fuels, excess air, mass balance, actual combustion. Exhaust gas analysis. A/F ratio, energy balance for a chemical reaction, combustion efficiency. **10 Hrs**

Unit - IV

Pure Substances: P-T and P-V diagrams, triple point and critical points, sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of pure substance with water as example. Enthalpy of change of phase (Latent heat), Dryness fraction (quality) representation of various processes on T-S & H-S diagrams.

Vapour Power Cycles: Carnot vapour power cycle, simple Rankine cycle, actual vapour power cycles, ideal and practical regenerative Rankine cycles, open and closed feed water heaters, Reheat Rankine cycle and characteristics of an Ideal working fluid in vapour power cycles. **10Hrs**

Unit - V

Gas power cycles

Air standard cycles-Otto cycle, Diesel cycle and Dual cycle, computation of thermal efficiency and mean effective pressure, comparison of Otto, Diesel & Dual cycles.

Gas turbine Cycles: Introduction and classification of gas turbine, gas turbine (Brayton) cycle; description and thermal analysis and methods to improve thermal efficiency of gas turbines. **10Hrs**

Reference Books:

1) P. K. Nag. Engineering Thermodynamics. McGraw Hill Education, 2013
2) Sonntag and Borgnakke. Fundamentals of thermodynamics. University of Michigan Wiley Publications 2013

3) Yunus A. Çengel, Michael A. Boles Thermodynamics: An Engineering Approach. McGraw-Hill Higher Education, 2006.
4) M.D.Burghardt and J A Harbach. Engineering Thermodynamics. Harper Collins college publishers 1993.

22UMEC301	Materials Science & Engineering	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Basic concepts regarding structure-property-processing relations across all material classes.
2. Modern materials like special steels, Super alloys and Composites.
3. Material selection for a given application.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss various crystal structures, imperfections in materials and industrial applications of atomic diffusion.	-	1,2	-
CO-2	Describe mechanical properties, strengthening mechanisms of materials and their significance.	1,2	-	-
CO-3	Interpret the phase diagrams for simple solid solutions and Iron-Iron carbide system.	1	2	3
CO-4	Discuss TTT, CCT curves and heat treatment schemes.	1	2	-
CO-5	Outline the classification, properties and applications of ferrous, nonferrous, ceramics & composites.	-	1	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.6	2.2	1	-	-	-	-	-	-	-	-	-	-	-

Prerequisites: Nil
Course Contents:

Unit - I

Crystal Structures: Classification of materials, BCC, FCC & HCP crystal structures, imperfections in crystals-point, line & surface defects. Atomic Diffusion: Basic

concepts, significance of diffusion, Fick"s laws of diffusion, Factors influencing diffusion, Industrial applications of diffusion. **8 Hrs**

Unit - II

Mechanical Properties of Metals: Elastic deformation, Plastic deformation, Materials Failure: Fundamentals of fracture – Brittle & ductile fractures, Tensile test, Hardness tests, Fatigue: Cyclic stresses, S-N curve, crack initiation & propagation, fatigue test. Creep: Generalized creep behavior, stresses & temperature effects, creep test.

Strengthening mechanisms: Mechanisms of strengthening in metals-Grain size reduction, solid solution strengthening and strain hardening. **8 Hrs**

Unit - III

Phase Diagrams: Types of solid solutions, Hume – Rothery rules, Lever rule. Classification and construction & interpretations of phase diagrams, Isomorphous, Eutectic, eutectoid & Peritectic systems. Iron-Iron carbon diagram – Construction and Interpretation, development of microstructure in Iron-Carbon alloys. **7 Hrs**

Unit - IV

Phase transformations: Kinetics of phase transformations, homogeneous and heterogeneous nucleation. Micro structural and property changes in Iron carbon alloys, Isothermal transformation diagrams (TTT curves) and continuous cooling transformation diagrams (CCT curves). Heat treatments: Basic concepts, objectives, Annealing – types and applications, Hardening – Hardenability, Jominy end quench test.

Metal alloys: Ferrous alloys and **Non-Ferrous Alloys: :** Classification, AISI / UNS designations mechanical characteristics of steels and copper/aluminimum and its alloys. **8 Hrs**

Unit – V

Composite materials - Definition, classification, types of matrix materials & reinforcements: **PARTICLE-REINFORCED COMPOSITES:** Large-Particle Composites, Dispersion-Strengthened Composites. **FIBER-REINFORCED COMPOSITES:** Influence of Fiber Length, Influence of Fiber Orientation and Concentration, The Fiber Phase, The Matrix Phase. Polymer-Matrix Composites Metal-Matrix Composites, Ceramic-Matrix Composite, Carbon–Carbon Composites, Hybrid Composites, Processing of Fiber-Reinforced Composites. **STRUCTURAL COMPOSITES**: Laminar Composites, Sandwich Panels, Nanocomposites. **Applications** of composite materials. Numerical on determining properties of composites.

Ceramics: A basic concept, Classification, features of glasses, clay products, refractories, abrasives and advanced ceramics & applications. **8 Hrs**

Reference Books:

1) William D. Callister, “Materials science & Engg”, An Introduction, John Wiley & Sons Inc, 2010.
2) V Raghavan, “Materials Science & Engg.”, 4th Edition, Prentice Hall of India, 2002.
3) William F. Smith, “Principles of Materials Science Engg.”, 3rd International Edition, McGraw Hill Publishing Co.1996
4) Donald R. Askelandad Pradeep P. Phule, “The Science and Engineering of Materials”, Thomson Books/Cole, 2010.

22UMEC302	Mechanics of Materials	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Theory behind design and analysis and procedures of rod like members subject to axial force, twisting and bending
2. Compound stresses and equations to calculate the same (analytical and graphical)
3. Buckling of columns & calculation of buckling load.
4. Nature of stresses in thick and thin cylinders and calculations.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Evaluate stresses and strains for structural members subjected to different loads.	1, 2	-	-
CO-2	Calculate principal stresses and maximum shear stress under combined loading.	1, 2	-	-
CO-3	Compute shear force, bending moment and deflection of beams subjected to different loads.	1, 2	3	-
CO-4	Use concepts of theory of simple bending and torsion to calculate stresses in elements	1, 2	3	-
CO-5	Analyze stresses and deformation in thin and thick cylinders & Calculate critical load in columns using Euler's or Rankine's equations	1, 2	3	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	3	2	-	-	-	-	-	-	-	-	-	-	-

Pre-requisites: Nil

Course Contents:

Unit - I

Stress and Strain: Introduction, mechanical properties of materials, Linear elasticity, Hooke's law, Poisson's ratio, stress-strain relationship, Extension and shortening of a bar, bars with varying cross section in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self-weight, factor of safety, thermal stresses. Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shears strain. **10 Hrs**

Unit - II

Torsion of circular shaft: Introduction, pure torsion, assumptions, torsion equation, pure torsion equation, power transmitted in circular shaft, Compound Cylinder.

Compound stresses: Introduction, Plane stress, stresses on inclined sections, analytical and graphical (Mohr's Circle) methods, Principal Stresses, Maximum shear Stress.

8 Hrs

Unit - III

Bending moment and shear forces in beams: Introduction, types of beams, loads and reactions, shear force and bending moments, sign convention, relationship between shear force and bending moment, shear force and bending moment diagrams for different beams subjected to uniformly distributed load, concentrated load, and couples.

Deflection in beams: Introduction, equation for deflection, slope and moments, double integration method, Macaualy's Method.

7 Hrs

Unit - IV

Stresses in beams: Introduction, theory of simple bending, Euler's equation of bending, shear stresses in beams, shear stresses across rectangular, circular, symmetrical and unsymmetrical and T sections. **8 Hrs**

Unit - V

Columns: Introduction to columns, Euler formula for different end conditions, its limitations, Rankine formula.

Thick and thin cylinders: Stresses in thin cylinders, changes in dimensions of thin cylinders, thick cylinders subjected to internal and external pressure.

6 Hrs

Text Book:

1) Singer & Pytel, “Strength of Materials”, Harper and Row publications.4th edition, 1999.

Reference Books:

1) Dr. S. S. Bhavikatti, “Strength of Materials”, 2nd edition, Vikas Publishing House Pvt. Ltd., 2003.
2) Ferdinand Beer & Russel Johnston, “Mechanics of materials”, 5th edition, Tata McGraw Hill, 2010.
3) Egor P Popov, “Mechanics of Materials”, Pearson Education India, 2nd edition, 1998.

22UMEL303 Materials Science and Materials Testing Laboratory (0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. To conduct experiments for finding mechanical properties of structural materials.
2. To identify whether a specific property of the material is suitable for intended applications.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Characterize the properties of materials subjected to tension, compression, bending, torsion and shear.	1, 4, 9	5	6
CO-2	Determine relevant parameters of fatigue and wear tests.	1, 4, 9	5	6
CO-3	Determine the impact strength of given specimen.	1, 4, 9	5	6
CO-4	Estimate the hardness of heat treated/untreated materials.	1, 4, 9	-	6
CO-5	Identify different materials by microstructure examination and detect various defects.	1, 4, 9	5	6

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	-	-	3	2	1	-	-	3	-	-	-	-	-

Prerequisites: Nil

Course Contents:

1. Study the microstructure of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze.
2. Determination of material behaviour using Tensile test
3. Determination of material behaviour using Shear test
4. Determination of material behaviour using Compression test
5. Determination of material behaviour using Torsion and bending test

6. Determination of impact behaviour using Izod test
7. Determination of impact behaviour using Charpy test
8. Determination of frictional force and wear using POD apparatus.
9. Brinell, Rockwell and Vicker's Hardness tests.
10. Determination of fatigue life using Fatigue Test
11. Non-destructive test experiments (Demonstration only)
    (a) Magnetic crack detector,
    (b) Dye penetrant testing.

References:

1. ASTM and IS Standards for Testing Procedures
2. Singer & Pytel, “Strength of Materials”, Harper and Row publications.4th edition, 1999.

22UMEL304	Foundry & Forging Laboratory	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Identify various foundry and forging tools & equipment.
2. Preparation of sand molds through hands on practice
3. Preparation of forging models using open hearth furnace by performing upsetting, drawing and bending operations.
4. Experimental procedures to determine different properties of sand samples

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify the various tools and operations used in foundry & forging process.	1	-	5
CO-2	Prepare different types of sand moulds using foundry tools and operations.	-	4	-
CO-3	Determine different properties of sand using appropriate tests.	-	4	-
CO-4	Prepare forging models using appropriate tools and operations.	-	4	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	-	-	2	1	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

1. Testing of mould sand using Compression and shear test
2. Testing of mould sand using Permeability test
3. Testing of mould sand using Mould hardness test
4. Testing of mould sand using Grain fineness number (GFN) test
5. Testing of mould sand using Clay content test
6. **Foundry Practice:** Use of foundry tools and other equipment. Preparation of moulds (ready to pour) using two boxes, use of split pattern, match plate pattern (only demonstration).
7. **Forging Models:** Preparing forging models involving upsetting, drawing and bending operations.

References:

1. O.P Khanna. Foundry Technology. Dhanpatrai Publications 2011.
2. Richard W Henie, Carle, R Loper, Philip C Rosenthal. Principal of Metal Casting. Mc Graw Hill Publications. 2018

22USMEC305	Machine Drawing	(3-0-2) 3

Contact Hours: 39

Course learning objectives (CLOs): The objectives of this course are to make the student to learn:

1. Importance of making drawings of machine parts as per standards.
2. Detailed drawings of machines parts from assembly drawing and vice versa.
3. Geometrical dimensioning & tolerancing
4. Solid modeling of Screw Jack, Plummer Block using software.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Convert the given pictorial views to orthographic views of machine parts/objects.	1	-	-
CO-2	Draw the orthographic views of plates fastened with threaded fasteners.	1	-	-
CO-3	Specify the tolerances on parts using GD & T.	1	2	-
CO-4	Draw part/assembly drawings of simple mechanical devices.	1	-	-
CO-5	Model mechanical parts and relevant assembly using the software.	-	1, 5	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.8	2	-	-	2	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Unit - I

Orthographic views (2D): BIS conventions. Conversion/drawing of pictorial views into orthographic views of simple machine parts with/without section on drawing sheet using drawing instruments. **7Hrs**

Unit - II

Thread forms and threaded fasteners: Sectional views of threads, ISO Metric (Internal & External), and square threads. Assembly of two plates using Hexagonal headed bolt and nut with washer, simple assembly using stud with nut and washer on drawing sheet using drawing instruments.

Couplings (2D): Protected type flange coupling assembly on drawing sheet using drawing instruments. **8 Hrs**

Unit - III

GD & T: Part drawings of a press tool representing various geometrical features and their tolerances. **6 Hrs**

Unit - IV

Assembly Drawings (2D): Assembly drawing of Screw jack (Bottle type), assembly drawing of Plummer block on drawing sheet using drawing instruments showing tolerances. **11 Hrs**

Unit – V

Computer aided 3D modelling (using Solid edge software):
Screw jack- part modelling, assembly, generation of 2D drawings and dimensioning using GD &T. **7 Hrs**

Reference Books:

1) K.R.Gopalkrishna, 'Machine Drawing', 22nd Edition, Subhas Publication 2013.
2) N.D.Bhatt, 'Machine Drawing', 45th edition, Charotar Publishers, 2008
3) A Primer on Computer Aided Machine Drawing-2007`, VTU, Belgaum
4) Sham Tickoo,N. Siddeshwar, P. Kanniah, V.V.S. Sastri, 'Auto CAD 2006, for engineers and designers', Dream tech 2005, Tata McGraw Hill, 2006.
5) K C John 'Text Book of Machine Drawing' PHI Learning Pvt Ltd, 2009.

NOTE:

1) The QP pattern of IA and SEE are different from that of all other subjects as it involves only drawing work.
2) The unit wise marks distribution is also different
   Unit -I: 2 Questions, each of 25 marks
   Unit-II: 2 Questions, each of 25 marks
   Unit-III: 2 Questions, each of 10 marks
   Unit-IV: 2 Questions, each of 40 marks
3) Unit-V: NO QUESTIONS IN *IA* OR *SEE. (Only for CTA)* The QP pattern / assessment of CIE and SEE modalities have been approved by the BOS.

22UHVK306	Universal Human Values-I	(1-0-0) 1

Contact Hours: 13

Course Learning Objectives (CLOs):
This course provides an opportunity for the students to enhance their life skills like right understanding leading to the harmonious living in relationship with the self and family enhancing holistic development of the students.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite and follow interpersonal relations with peers and the others	6	-	-
CO-2	Comprehend happiness, prosperity and distinguish between body and self	-	6,9	-
CO-3	Comprehend harmony and practice Sanyam and Svasthya	-	9	-
CO-4	Demonstrate the values of human-human interaction and universal values such as Nyaya, Visvasa, and Sammana	7	-	-
CO-5	Clearly visualize the co-relation between lack of Human Values and the prevailing problems and use tangible steps and a roadmap for moving in the cherished direction.	8	9	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	-	-	-	-	-	2.5	3	3	2	-	-	-

Course Contents:

Introduction to Value Education: 3Hrs

- Understanding the need, basic guidelines, content and process for Value Education
- Self-exploration – its content and process; 'Natural Acceptance' and Experiential Validation – as the mechanism for self-exploration
- Continuous Happiness and Prosperity – A look at basic human aspirations

- Right understanding, Relationship and Physical Facilities – The basic requirements for fulfillment of aspirations of every human being
- Understanding Happiness and Prosperity correctly – A critical appraisal of the current scenario and Method to fulfill the above human aspirations: Understanding and living in harmony at various levels

Unit-II

Understanding Happiness, Prosperity and Harmony in the Human Being 3Hrs

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body' and the needs of Self ('I') and 'Body' - Sukh and Suvidhã
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the harmony of 'I' with the Body: Sanyam and Svãsthya; correct appraisal of physical needs, meaning of prosperity in detail
- Programs to ensure Sanyam and Svãsthya

Unit-III

Harmony in the Family & Harmony in the Society 3Hrs

- Understanding harmony in the Family – the basic unit of human interaction
- Understanding values in human-human relationship; meaning of Nyãya and program for its fulfillment to ensure Ubhaya –tripti; Trust (Visvãsa) and Respect (Sammãna) as the foundational values of relationship; the other salient values in relationship.
- Understanding the harmony in the society (society being an extension of family): Samãdhãna, Samriddhi, Abhaya, Sah-astitva as comprehensive Human Goals
- Visualizing a universal harmonious order in society – Undivided Society (Akhand Samãj), Universal Order (Sãrvabhauma Vyavasthã)- from family to world family.

Unit-IV

Understanding Harmony in the Nature (Existence) 2Hrs

- Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature – recyclability and self-regulation in nature
- Understanding existence as co-existence (Sah-astitva) of mutually interacting units in all-pervasive space
- Holistic perception of harmony at all levels of existence

Unit-V

Implications of the Holistic Understanding & A Look at Professional Ethics

3Hrs

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
- Competence in Professional Ethics:
  (a) Ability to utilize the professional competence for augmenting universal human order.

  (b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models.

Reference Book:

1) R.R.Gaur, R Asthana, and G.P Bagaria. A Foundation Course in Human Values and Professional Ethics: 3rd Revised Edn. UHV Foundation, New Delhi. 2023.
2) YouTube videos and lectures.

22UMEE321	Spreadsheet for Engineers	(0-0-2) 1

Contact Hours: 26 Hrs.

Course learning objectives (CLOs): The objectives of this course are to make the student to learn:

1. Create different plots and charts
2. Compute different functions, conditional functions and make regression analysis
3. Carryout iterative solutions for roots, multiple roots, optimization and non-linear regression analysis
4. Carryout matrix operations
5. VBA, UDF, VBA subroutines and Macros
6. Carryout numerical integration and solve differential equations using different methods

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Create different plots and charts	-	1, 2	-
CO-2	Compute different functions, conditional functions and make regression analysis	-	1, 2	-
CO-3	Carryout iterative solutions for roots, multiple roots, optimization, and non-linear regression analysis	-	1, 2	-
CO-4	Carryout matrix operations	-	1, 2	-
CO-5	Explain VBA and UDF, VBA subroutines and Macros	-		1,2
CO-6	Carryout numerical integration and solving differential equations using different methods	-	1,2	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping level	1.83	1.83	-	-	-	-	-	-	-	-	-	-

Course Contents:

1. **Charting:** Create an XY scatter graph, XY chart with two Y-Axes, add error bars to your plot, create a combination chart

2. **Functions:** Computing Sum, Average, Count, Max and Min, Computing Weighted Average, Trigonometric Functions, Exponential Functions, Using the CONVERT Function to Convert Units
3. **Conditional Functions:** Logical Expressions, Boolean Functions, IF Function, Creating a Quadratic Equation Solver, Table VLOOKUP Function, AND, OR and XOR functions.
4. **Regression Analysis:** Trendline, Slope and Intercept, Interpolation and Forecast, The LINEST Function, Multilinear Regression, Polynomial Fit Functions, Residuals Plot, Slope and Tangent, Analysis Tool Pack.
5. **Iterative Solutions Using Excel:** Using Goal Seek in Excel, Using the Solver to Find Roots, Finding Multiple Roots, Optimization Using the Solver, Minimization Analysis, Non-Linear Regression Analysis.
6. **Matrix Operations Using Excel:** Adding Two Matrices, multiplying a Matrix by a Scalar, Multiplying Two Matrices, transposing a Matrix, inverting a Matrix and Solving System of Linear Equations.
7. **VBA User-Defined Functions (UDF):** The Visual Basic Editor (VBE), The IF Structure, The Select Case Structure, The for Next Structure, The Do Loop Structure, Declaring Variables and Data Types, An Array Function the Excel Object Model, For Each Next Structure.
8. **VBA Subroutines or Macros:** Recording a Macro, coding a Macro Finding Roots by Bisection, Using Arrays, adding a Control and Creating User Forms.

Demonstration Experiments (For CIE)

9. **Numerical Integration Using Excel:** The Rectangle Rule, The Trapezoid Rule, The Simpson's Rule, creating a User-Defined Function Using the Simpson's Rule.
10. **Differential Equations:** Euler's Method, Modified Euler's Method, The Runge Kutta Method, Solving a Second Order Differential Equation

References:

1. Excel Resources - 600+ Self Study Guides, Articles & Tools (wallstreetmojo.com)
2. https://www.ictlounge.com/html/year_7/esafety_part7.htm
3. McFedries Paul “Microsoft Excel 2019 Formulas and Functions”, Microsoft Press, U.S, 2019, Edition

22UMBA301	Mathematics	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course will enable students to master the basic tools of differential & integral calculus, differential equations and partial differential equations and become skilled to formulate, solve and analyze science and engineering problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Apply** the knowledge of calculus to solve problems related to polar curves, curvature and its applications in determining the bentness of a curve.	-	-	1,2
CO-2	**Solve** multiple integration and use Beta and Gamma function to solve definite integrals	-	1,2	-
CO-3	**Solve** first order linear differential equations analytically using standard methods.	-	1,2	-
CO-4	**Solve** higher order differential equations with constant co-efficients and variable co-efficients.	-	1,2	-
CO-5	**Learn** partial differentiation to calculate rates of change of multivariate functions. Solve problems related to composite functions and Jacobians. Solve problems on partial differential equations by method of separation of variables.	-	-	1,2

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	1.6	1.6	-	-	-	-	-	-		-	-	-

Pre-requisites:

1. Differentiation of function

2. Integration of function.

Course Content:

Unit-I

Differential Calculus: n^{th} order differentiation of standard functions. Leibnitz theorem (Statement only & illustrative examples), Taylor's series for single variable (Statement only & illustrative examples), Maclaurin's series for single variable (Statement only & illustrative examples).

Polar curves-angle between the radius vector and tangent (Formula & illustrative examples), angle between two curves (Formula & illustrative examples). Definition of Curvature and radius of curvature. -Radius of curvature for Cartesian and polar curves (Formulas & illustrative examples). **10Hrs**

Unit-II

Integral Calculus: Reduction formula for $\int_0^{\pi/2} sin^n x\, dx, \int_0^{\pi/2} cos^n x\, dx$ and $\int_0^{\pi/2} sin^n x\, cos^m x\, dx$ (Formula & illustrative examples). Definition of Beta and Gamma functions (illustrative examples). Relation between Beta and Gamma functions (No Proof) (illustrative examples).Evaluation of Double integral (direct and region given), Change of variables. Evaluation of Triple integral (direct examples).

10Hrs.

Unit-III

Ordinary Differential Equations of first order: -
Libnitz's Linear differential equation, Bernoulli's differential equation, Exact differential equations. Orthogonal trajectories. **5Hrs**.

Unit-IV

Differential Equations of higher order

Solution of Second order Linear ordinary differential equation with constant coefficients. Method of variation of parameters. Legendre's homogeneous equations.

8Hrs.

Unit-V

Partial Differentiation:

Definition of Partial derivative (illustrative examples), Total differentiation (illustrative examples), Differentiation of Composite functions (illustrative examples). Jacobians and its properties (No Proof) (illustrative examples).

Partial Differential Equations (PDE's):
Formation of PDE's by elimination of arbitrary constants /functions. Solution of PDE by variable separable method. **6Hrs.**

Text Books

1. **B.S. Grewal**: Higher Engineering Mathematics, Khanna Publishers, 44th edition,2017.
2. **H.K.Dass & Rajnish Verma**,Higher Engineering Mathematics,3rd edition, 2014.

Note: 1. Grades (i) PP (ii) NP
2. No semester End Examination
3. Audit (Bridge course).

1. The mandatory non – credit courses Mathematics for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B.Tech., programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE.

2. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

22UPYK307	Physical Education and Yoga	(0-0-2) Audit

Contact Hours: 26

Course Learning Objectives:

1. The course focuses on overall development and importance of Physical Education & Yoga in day to day life.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Gaining the importance of Physical Education & yoga	12	-	8, 9
CO2	Understanding the benefits & preventive measures of health	12	6	8, 9
CO3	Gaining the knowledge of yoga	12	-	8, 9
CO4	Understanding the importance of Human Body conditioning & Sports training	12	-	8, 9
CO5	Get awareness of Modern technology in sports	12	-	5, 8, 9

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	-	-	-	-	1	2	-	1	1	-	-	3

Contents

Unit-I

Introduction to Physical Education: Meaning and importance, definition, components, benefits of Physical Education. **4Hrs**

Unit-II

Health and wellness, Anatomy and Physiology: Meaning and importance, definition, components, benefits, ealth habits, basics of diseases and preventive measures, mental health, physical health, social health, spiritual health. Meaning and definition, first aid, injuries and preventions. **5Hrs**

Unit-III

Introduction of Yoga: Origin and history of Yoga, meaning and definition, benefits, importance, prayer, Suryanamaskara,

Asana:- Vrikshasana, Padmasana, Bhujangasana, Halasana.
Pranayama:-Anuloma viloma praanayama,
Mudras:- China mudra, Bhrama Mudra. **6Hrs**

Unit-IV

Sports Training: Meaning and definitions, warming up, cooldown, methods of exercises, stretching, speed, endurance, flexibility, agility, Athletics, Karata, Caracket, Basketball, Handball, Kho Kho & Volleyball Rules and regulation of all games. **6 Hrs**

Unit-V

Modern Technology in Sports and Games: Meaning and definitions, objectives, assisting umpires, referees, hawk-eye technology, sports specific, computer software, technology in playfields, athletes clothing and equipment, graphics of sports and games, artificial intelligence. **5Hrs**

Reference Books:

1) Petipus, et al., Athlete's Guide to Career Planning, Human Kinetics, 1997
2) The Human Body in Health and Disease with Access 8th Edition 2023.
3) Anatomy and Physiology, Shri K.G. Nadgir College of Physical Education. Dharwad.
4) Health & Wellness Shri K.G. Nadgir College of Physical Education. Dharwad.
5) Nagendra HR., The art and science of Pranayama, 2009
6) Iyengar BKS., The illustrated Light on Yoga(English), 2005

IV Semester

22UMAC400	Engineering Mathematics-IV	(2-2-0)3

Contact Hours:39

Course Learning Objectives (CLOs):

1. Provide an insight into applications of conformal mapping. Integration of complex functions.
2. Apply probability distributions in Engineering.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Construct** and use the concepts of analytic function to solve the problems arising in Engineering field.	-	-	1,2
CO-2	**Utilize** conformal transformation and complex integral to transform irregular domain onto a relatively simple domain.	-	-	1,2
CO-3	**Apply** discrete and continuous probability distributions in analyzing the probability models arising in engineering field.	-	-	1,2,12
CO-4	**Estimate** the correlation, covariance using joint probability distributions. **Recite** Markov chains and describe stochastic process.	-	-	1,2,12
CO-5	**Use** student's t-distribution, Chi-square distribution as a test of goodness of fit .	-	-	1,2,12

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	1	1	-	-	-	-	-	-		-	-	1

Pre-requisites: Knowledge of fundamentals of calculus, Basics of statistics and probability theory.

Contents:

Unit-1

Calculus of complex functions: Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms. Construction of analytic functions: Milne-Thomson method-Problems. **8Hrs.**

Unit-2

Conformal transformations:
Introduction. Discussion of conformal transformations:
$\mathbf{w}= e^{z}; w = z^{2}, w = z + \frac{1}{z}, z \neq o$. Bilinear transformations- Problems.
Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's Integral theorem. **8Hrs.**

Unit-3

Probability Distributions: Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, Exponential and normal distributions- problems (No derivation for mean and standard deviation)- Illustrative examples. **8Hrs.**

Unit-4

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.
Markov chains– Introduction, probability vectors, Stochastic Matrices, Fixed points and Regular stochastic matrices, Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states. **8Hrs.**

Unit-5

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. **8Hrs.**

Reference Books:

1. **B.S. Grewal**: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
2. **E. Kreyszig**: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.
3. **PeterV.O'Neil**: Advanced Engineering Mathematics, International student's edition, 2011.
4. **Kishor S. Trivedi**: Probability& Statistics with Reliability, Queuing, and Computer Science Applications, Prentice-Hall of India, 2005.
5. **N. P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" LaxmiPublications,10th Ed., 2022.

22UMEC400	Design of Machine Elements	(2-2-0) 3

Contact Hours:39

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Materials and properties used in machine elements.
2. Theories of failures and application.
3. Design commonly used machine elements used for joining and power transmission.
4. Use of design data book and BIS standards.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Solve problems on eccentric loading & theories of failure in design of machine components using factor of safety.	-	1, 2	-
CO-2	Design power transmission elements like shafts, keys and couplings.	1, 2	3	6
CO-3	Evaluate stress concentration and fatigue strength of machine elements.	1, 2	3	-
CO-4	Design Knuckle joint and power screws.	1, 2	3	6
CO-5	Design joints using threaded fasteners, welded and riveted joints.	1, 2	3	6

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.8	2.8	2	-	-	1	-	-	-	-	-	-	-	-

Prerequisites: Strength of materials.

Course Contents:

Unit – I

Introduction: Design methodologies, stress analysis, problems on axial, bending, torsional, eccentric loading for simple members of circular & rectangular cross section, stress due to impact loading (no derivation).

Role of materials, material selection, factor of safety, calculation of allowable stresses, theories of failure (max. of principal stress theory, shear stress theory, distortion energy theory). **7 Hrs**

Unit – II

Keys & coupling: Selection of keys, check for stresses, design of flange coupling.

Design of shafts: Strength & deflection–ASME code for transmission shafting, including axial loads – (problems not involving more than 2 transmitting elements). **9 Hrs**

Unit III

Stress concentration: Effects of stress concentration, problems on stress concentration (discontinuity of max. two discontinuities)

Design for fatigue strength: Introduction, S-N diagram, low cycle fatigue, high cycle fatigue, and Endurance limit. Modifying factors – size effect, surface effect, stress concentration effects; Fluctuating stresses, Fatigue strength under fluctuating stresses, Goodman's and Soderberg's relationship; stresses due to combined loading. **7 Hrs**

Unit – IV

Design of knuckle joint: Modes of failures in various parts of knuckle joint.

Design of Power Screws Mechanics of power screw, stresses in power screws, Efficiency and elf-locking. **9 Hrs**

Unit-V

Design of Fasteners: Fastener, initial tension concept eccentrically loaded bolted joints – for Brackets & hangers & base of crane etc.

Riveted joints: Types, failures, design of structural joints – lap & butt joints, eccentric loading problems to be given as assignment (No boiler joints) Lozenge Joint.

Design of welded joints: Lap joint, butt joint, eccentric welded joint subjected to torsional and bending moments (standard configuration only)

7Hrs

Text Book:

1) Robert L. Norton, "Machine Design an integrated approach", 2nd edition, Pearson Education Asia University Press, 2013.

Reference Books:

1) Joseph. E Shigley & Charles R MirchKe, “Mechanical Engg. Design”, 6th edition, Tata, McGraw Hill, 2003.
2) C. S. Sharma and Kamlesh Purohit, “Design of Machine Elements”, PHI 2003.
3) Maleev & Hartman, “Machine Design”, CBS Publishers & Distribution, New Delhi.
4) V. B. Bhandari, “Design of Machine Elements”, 3rd edition, Tata McGraw Hill Pub. New Delhi, 2010.

Design Data Hand Books:

1) K. Mahadevan & Balaveera Reddy, “Design Data Hand Book”, CBS Publication, 2014.
2) K. Lingaiah, “Design Data Hand Book”, McGraw Hill, 2006.

22UMEC401	Manufacturing Processes	(3-0-0) 3

Contact Hours:39

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Concepts of heating the metal to molten state and cooling it in a cavity of desired shape and size.
2. Methods of metal forming processes and related aspects.
3. Theory of metal cutting and operations of various machines.
4. Methods of joining two metal pieces with application of heat, with or without pressure and extra metal (filler metal)
5. Different metal additive processes.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13,14)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the principles of casting, Moulding, Moulding machines and furnaces.	-	1	-
CO-2	Describe high energy rate forming processes.	-	1, 2	-
CO-3	Discuss Theory of metal cutting and Nontraditional machining processes.	1,2	-	-
CO-4	Discuss various metal joining processes.	1,2	-	-
CO-5	Explain the basic concepts of prototyping and related processes.	1,2	-	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.6	2.7	-	-	-	-	-	-	-	-	-	-	-	-

Course Contents:

Unit – I

Casting principles: Introduction, steps involved in casting process, advantages, dis-advantages and applications of the casting process.
Pattern: Definition, materials used for patterns (any four), pattern allowances and their importance, types of patterns.
Sand moulding: Ingredients in moulding sand, types of moulding sand, properties of an ideal moulding sand.
Core: core sand, binders, core making, types of cores.
Moulding Machines: Jolt-squeeze machine moulding, sand slinger, Investment casting, centrifugal casting, continuous casting.
Casting defects: Causes and remedies.
Melting furnaces: Cupola, Induction furnace. **8 Hrs**

Unit - II

Metal forming process: Introduction to metal forming processes, Flow curve, Classification based on applied force & temperature. Merits & demerits.

Forging: Introduction, Classification, defects: causes and remedies. Forging load calculations.

Rolling: Introduction, classification of rolling mill, force & geometry relationship, rolling load and power (no derivation), rolling defects: causes and remedies. **7 Hrs**

Unit - III

Theory of Metal Cutting: Single point cutting tool geometry and nomenclature – machine reference (ASA), orthogonal rake system (ORS), Mechanics of chip formation, types of chips, orthogonal and oblique cutting, relationship between chip thickness ratio, shear angle and rake angle in orthogonal
machining. Velocity relationships. Merchant's analysis, Merchant's theory.

Cutting tool materials: properties, types.

Tool wear, cutting fluids and Machinability: Types, mechanism, tool life criterion. Taylor's tool life equation. Cutting fluids - desired properties, types, selection. Factors affecting Machinability.

Non-Traditional Machining Processes: Classification, EDM, ECM, and LBM processes. **9 Hrs**

Unit - IV

Metal Joining Processes: Soldering, brazing, Welding - Arc welding, TIG, MIG, SAW, Resistance, Friction, Heat affected zone with analysis.

Advanced metal joining processes: Explosive, Electron beam welding, Laser Beam Welding and thermit welding, **8 Hrs**

Unit - V

Introduction to additive manufacturing: Traditional Prototyping Vs. Rapid Prototyping (RP),

Classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process. Need for the compression in product development, Survey of applications and classification of RP systems.

Principle, Process parameter, Process details, Application, Advantages and disadvantages of Stereo Lithography Systems, Selective Laser Sintering, Fusion Deposition Modelling, Solid Ground Curing and Laminated Object Manufacturing. Stereo Lithography Systems. **7 Hrs**

Reference Books:

1) Serope Kalpakjian and Steven R Schmid, "Manufacturing Engineering and Technology", Pearson Education Asia, 4th edition,2001
2) A.B. Chattopadhyay, "Machining and Machine tools", Willey India, 2011.
3) Geoffrey Boothroyd and Winston A. Knight, Fundamentals of Machining and Machine Tools, 3rd edition, CRC Press. Taylor and Francis Group.
4) Chua C K, Leong K F, Chu S L, "Rapid Prototyping", Principles and Applications in Manufacturing, World Scientific.

5) Amitabh Ghosh & A. K. Mallik, “Manufacturing Science”, 2nd edition, East West Press, 2010.
6) O. P. Khanna “Manufacturing Process”, Dhanpat Rai Publishing Co. Pvt. Ltd, 2009.
7) Gibson D W Rosen, Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer.
8) Noorani R, “Rapid Prototyping: Principles and Applications in Manufacturing”, John Wiley & Sons.
9) Hilton P, Jacobs P F, “Rapid Tooling: Technologies and Industrial Applications”, CRC press.

22UMEC402	Fluid Mechanics	(2-2-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Fluid and its properties,
2. Laws of static fluids,
3. Fluid flow concepts,
4. Fluid dynamics, flow through pipes, compressible flow and boundary layer concepts.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Evaluate fluid properties and pressure of fluid flow	1, 2	-	-
CO-2	Determine hydrostatic forces on submerged surfaces and kinematic properties of fluid.	1, 2	-	-
CO-3	Apply laws governing fluid dynamics to flow measurement and carry out dimensional analysis.	1, 2	-	3
CO-4	Apply equations of fluid friction for flow through pipes.	1, 2	-	3
CO-5	Explain the concepts of boundary layer theory and its applications.	-	1, 2	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.8	2.8	1	-	-	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Unit - I

Properties of fluids, Fluid Statics: Review of fluid properties and numericals, Pascal's law, pressure variation in static fluid, manometers (simple, differential U tube and micro manometers). Mechanical gauges **8 Hrs**

Unit - II

Submerged surfaces & Floatation: Hydrostatic force on submerged plane surfaces (horizontal, vertical and inclined). Buoyancy and stability criteria

Fluid Kinematics: Fluid flow concepts, types of flow, lines of flow, continuity equation, stream function and velocity potential function for 2D flow, Relationship between them and flow nets **8 Hrs**

Unit - III

Dimensional Analysis: Dimensions of physical quantities, dimensional homogeneity-Buckingham's pi theorem, the Rayleigh's method, important dimensionless numbers, Critical Reynolds number, similitude.

Fluid Dynamics & its applications: Euler's Equation of motion, Bernoulli's equation, venturi meter, orifice meter, pitot tube, V- notch, Rota meter, Hot wire Anemometer and Methods of fluid flow visualization. Navier stoke equation (no derivation), **8Hrs**

Unit - IV

Flow through Pipes: Laminar and turbulent flow, flow through circular pipe, Hagen Poisuille's equation, power absorbed in viscous flow, minor and major losses in pipe flow: Darcy equation Chezy equation, flow network,- Energy line and hydraulic gradient line **8Hrs**

Unit - V

Boundary layer theory: Hydrodynamic boundary layer, boundary layer thickness, displacement, momentum & energy thickness, (Qualitative discussions and No derivations) Flow over a flat plate, Flow inside a pipe. Flow past immersed Bodies: Lift and Drag force, Introduction to Compressible fluid flow and CFD. **7 Hrs**

Reference Books:

1) Dr. R K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines" 9th edition, Laxmi Publication (P) Ltd., New Delhi. 2013
2) S.K.Som and Biswas "Introduction to Fluid Mechanics and fluid machines " 3rd edition ,TATA McGraw Hill publication, New Delhi. 2012
3) K.L. Kumar "Engineering Fluid Mechanics" S. Chand Publishing,
4) Yunus Cengel "Fluid Mechanics(SI units)" McGraw Hill, 2014
5) Dr.Jagadishlal, "Fluid Mechanics and Hydraulics" Metropolitan Book Co. Pvt. Ltd., New Delhi, 1995.
6) White, "Fluid Mechanics" 6th edition, Tata McGraw Hill 2010.
7) R.W Fox , A T McDonald T J Pritchard "Introduction to Fluid Mechanics" 6th edition, John wiley and sons. 2004

22UMEL403	Metrology and Measurements Laboratory	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Importance/need of mechanical measurements and metrology in day-to-day practical life.
2. Different measurements systems and the errors associated with them.
3. Importance of calibration of measurement instruments.
4. Various Sensors, traducers and strain gauges employed in measuring system.
5. Linear and angular measurements and calibration.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Calibrate pressure gauge, thermocouple, LVDT, load cell and micrometer.	1	4	5
CO-2	Measure angular dimensions and surface roughness.	-	-	1,5
CO-3	Determine screw thread and gear tooth parameters.	-	4	1,5
CO-4	Inspect parts using profile projector, tool maker's microscope and gauges.	1	-	6
CO-5	Measure surface roughness of parts	-	4	1, 5

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	-	-	2	1	1	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Course Contents:

1. Calibration of Pressure Gauge.
2. Calibration of Thermocouple.

3. Calibration of LVDT.
4. Calibration of Load cell.
5. Measurements using Optical Projector/Tool maker's Microscope.
6. Determination of angle using Sine bar / Sine Center / bevel protractor.
7. Determination of Screw thread parameters using three wire method.
8. Determination of gear tooth profile using gear tooth Vernier / gear tooth micrometer.
9. Calibration of a micrometer using slip gauges.
10. Measurements of Surface roughness

Demonstration experiments:

1. Use of limit gauges for inspection of components.
2. Checking of circular components for roundness
3. Measurement using Optical Flats

22UMEL404	Thermal Engineering Laboratory - I	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs): The objectives of this Laboratory are to make the student to learn:

1. Fuel properties such as calorific value, viscosity and flash and fire point.
2. Parameters affecting the Internal Combustion Engine performance and their measurement.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to Pos (1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Determine flash and fire point using different apparatus	-	4	3
CO-2	Determine the viscosity of given oil	-	4	3
CO-3	Determine calorific value of a fuel	-	3, 4	9
CO-4	Evaluate performance parameters of Petrol Engine	-	3, 4	9
CO-5	Evaluate performance parameters of diesel and alternate fuel powered engine	-	3, 4	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	-	-	1.6	2	-	-	-	-	1	-	-	-	-	-

Pre-requisites: NIL

Course Contents:

1. Determine the flash point and fire point of a given oil using Cleveland open cup apparatus.
2. Determine the flash point of given oil using Pensky-Martin closed cup apparatus.
3. Determine the flash point of given oil using Abels closed cup apparatus.
4. Determine the viscosity of oil using Red wood viscometer.
5. Determine the viscosity of oil using Say-bolt viscometer.
6. Determine calorific value of Gaseous fuel using Junkers Gas calorimeter.
7. Determine calorific value of solid fuel using Bomb calorimeter.
8. Performance test on four stroke IC engine and Heat balance sheet.
9. Performance test on VCR engine and Heat balance sheet.
10. Performance test on 2 stroke Petrol engine.
11. Performance testing of computerized IC Engine.

Demonstration experiment:

1) Bio Diesel production through trans-esterification.

22USMEC405	Metrology and Measurements	(2-2-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Need, standards and principles of measurement.
2. Basics of limits, fits and tolerances and their importance to the real manufacturing.
3. Principles of various mechanical elements – such as screws, threads and gears.
4. Basic principles of measurements systems.
5. Principles of various transducers.
6. Working of force, torque, pressure, temperature, strain measurement systems.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13,14)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain standards of measurements and principles of limits, fits & tolerances.	1	-	13
CO-2	Design limit gauges for internal and external dimensions and explain the working of various comparators.	1, 2	-	-
CO-3	Describe principles of interferometry, screw thread, gear and angular measurements.	1, 2	-	-
CO-4	Discuss Surface roughness, form measurement and concepts of advanced metrology.	1,2		3
CO-5	Discuss various methods of measurement of force, strain, torque, pressure and temperature.	1, 2	-	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	3	1	-	-	-	-	-	-	-	-	-	1	-

Prerequisites: Nil

Course Contents:

Unit - I

Standards of measurement: Definition and Objectives of metrology, Standards of length - International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, comparison, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Indian Standards (M-87, M-112),

Numerical problems on building of slip gauges.

System of limits, Fits, Tolerances: concept of limits of size and tolerances, Specification in assembly, Principle of inter changeability and selective assembly, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919 -1963), geometrical tolerance, positional - tolerances, hole basis system, shaft basis of system. **8 Hrs**

Unit - II

Limit gauges and gauge design: classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges- plain plug gauge, ring Gauge, snap gauge, limit gauge and gauge materials.

Comparators: Introduction to Comparator, Characteristics, classification of comparators, mechanical comparators -Johnson Mikrokator, Sigma Comparators, Optical Comparators -principles, Zeiss ultra-optimeter, Electric and Electronic Comparators -principles, LVDT, Pneumatic Comparators, back pressure gauges, Solex Comparators. **8 Hrs**

Unit - III

Angular measurement: Angular measurements, Bevel Protractor, Sine Principle and. use of Sine bars, Sine center, use of angle gauges, (numericals on building of angles) Clinometers.

Interferometry and Screw thread measurement: Interferometer Principle of interferometry, autocollimator, Optical flats, Toolmakers microscope. Terminology of screw threads, measurement of major diameter, minor diameter pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, Best size wire.

Gear measurement: gear terminology, use of gear tooth Vernier caliper and gear tooth micrometer.

8 Hrs

Unit - IV

Surface roughness measurement: Elements of surface texture, significance of surface roughness, cut-off length and evaluation length, evaluation of surface roughness- Ra, Rz, Rrms, symbols representing the surface roughness, problems on evaluation of surface roughness.

Form measurement: Straightness, flatness and roundness measurements.

Advanced metrology: Co-ordinate measuring machine (CMM) need, construction, types- applications in measurements and machine tool metrology, Introduction to computer aided inspection. **7 Hrs**

Unit - V

Measurement of Force, Torque and pressure: Principle, platform balance, proving ring, Torque measurement, Prony brake, hydraulic dynamometer. Pressure Measurements, Principle, Bridgeman gauge, Mcloed gauge.

Temperature and strain measurement: Thermocouple, laws of thermocouple, materials used for construction, pyrometer, Optical Pyrometer. Strain Measurements, Strain gauge, gauge factor. **8 Hrs**

Reference Books:

1) Beckwith Marangoni and Lienhard, “Mechanical measurements” Pearson Education, 6th Ed., 2007.
2) R. K. Jain, “Engineering Metrology”, 25th edition, Khanna Publishers, 2011.
3) I. C. Gupta, “Engineering Metrology”, 7th edition, Dhanpat Rai Publications, Delhi, 2012.
4) Alsutko, Jerry. D.Faulk, “Industrial Instrumentation” Thompson Asia Pvt. Ltd. 2002
5) Ernest O. Doebelin& Dhanish N. Manik, “Measurement Systems”, 6th editions, McGRAW Hill Book Co. 2011

22UHVK406	Universal Human Values - II	(1-0-0) 1

Contact Hours: 13

Course Learning Objectives (CLOs):

This course provides an opportunity for the students to enhance their life skills like right understanding leading to the harmonious living in relationship with the society and environment enhancing holistic development of the students.

Course Outcomes (COs):

Description of the course outcome: At the end of course, the student should be able to:		Mapping to POs (1-12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Recite and follow interpersonal relations with peers and the society.	6	-	-
CO-2	Demonstrate the concept of harmony in nature and need of self-regulation.	-	6,9	-
CO-3	Recite and follow Natural Acceptance and Differentiate between Intention and Competence.	-	9	-
CO-4	Differentiate between the characteristics and activities of different orders existing in Nature and demonstrate the role of human beings in mutual fulfillment with all the orders of Nature.	7	-	-
CO-5	Visualize and involve in the strategic preparation for Universal Human Order.	8	9	-

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Mapping level	-	-	-	-	-	2.5	3	3	2	-	-	-

Prerequisites: Nil

Course Contents:

UNIT I

Harmony in the Society: Understanding Universal Human **2 Hrs.**

Understanding Human Goal, Appraisal of the Current Status, The Way Ahead, Dimensions of Human Order

UNIT II

Harmony in the Nature **3 Hrs.**

Nature as Collection of Units: Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature – recyclability and self-regulation in nature, Understanding existence as co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Dependence of the Human Being on the Other Three Orders.

UNIT III

Harmony in Existence: Understanding Co-existence at Various Levels **3 Hrs.**

Existence as Units in Space, Understanding Submergence, Existence as Co-existence – Units Submerged in Space, Development in the Existential Sense, Expression of Co-existence at Different Levels, Understanding Role of Human Being in Existence.

UNIT IV

Ethical Human Conduct and Professional Ethics in the Light of Right Understanding **3 Hrs.**

Universal Values Naturally Emerging from the Right Understanding, Definitiveness of Ethical Human Conduct, Development of Human Consciousness, Implications of Value-based Living, Profession – in Context with the Comprehensive Human Goal, Ensuring Ethical Competence, Issues in Professional Ethics – The Current Scenario, Prevailing Approaches towards, Promotion of Professional Ethics – their Inadequacy, Inherent Contradictions and Dilemmas and Their Resolution.

UNIT V

Holistic Development towards Universal Human Order **2 Hrs.**

Visualization of Comprehensive Human Goal, Vision for Holistic Technologies, Production Systems and Management Models, Journey towards Universal Human Order – The Road Ahead

Reference Book:

1) R.R.Gaur, R Asthana, and G.P Bagaria. **A Foundation Course in HUMAN VALUES and professional Ethics**: 2nd Revised Edn. EXCEL BOOKS, New Delhi. 2019

22UMEE421	Electro- Mechanical Systems with IOT	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Electronics, and mechanical components and monitored by using Arduino/ Raspiry Pi.
2. Different Smart System applications.
3. Use of Arduino/ Raspberry Pi as IDE, programming language & platform.
4. Arduino boards and its basic components.
5. Design various smart system for mechanical applications

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** Arduino/ Raspberry Pi environment and its applications.	-	1	-
CO-2	**Explain** Arduino programming with Python/C++.	-	1	-
CO-3	**Design** Smart systems for Mechanical applications with IOT	2	3	-
CO-4	**Explain** the need for IDE, compiler, and chip in Arduino/ Raspberry Pi comp atible boards with IOT	-	2	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping level	2	2.5	2	-	-	-	-	-	-	-	-	-

Prerequisites: Basics Python Programming/C Programming/C++ Programming

Course contents:

Overview of IoT

Understanding IoT fundamentals, IOT Architecture, protocols, Various Platforms for IoT, Overview of IoT components and IoT Communication Technologies

Getting started with Arduino

Introduction to Arduino, hardware components, download and installation of Arduino IDE and understanding Arduino syntax. Setup computer with Arduino.

Getting started with Raspberry Pi

Introduction to Raspberry Pi, Pin Description of Raspberry Pi, On-board components of Rpi, Installing Raspbian on Pi, First boot and Basic Configuration of Pi

Introduction to Electronics components and Sensors,

Electronics Components, Various basic Industrial sensors, IR Digital sensors, light sensors, Sound sensors, Color IR sensors, and Application of sensors.

Introduction to Engineering Actuators and drive motors,

DC motors, DC gear Motors, stepper motors and servo motors, their application. Driving systems and types of driving systems and their application, H bridge motor drive, advance drive and Direction control of Servo Motor.

Part-A

Problem-1: Study the fundamental software and components and familiarize with Arduino/Raspberry Pi and perform necessary activities**.**

Problems-2: To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.

Programs-3: To interface Push button/Digital sensor with Arduino/Raspberry Piand write a program to turn ON LED when push button is pressed or at sensor detection

Problems-4: To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings

Problems-5: To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed

Experiment-6: To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.

Experiment-7: To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn ON/OFF when ’1‘/‘0‘ is received from smartphone using Bluetooth

Experiment-8: Write a program on Arduino/Raspberry Pi to upload temperature and

humidity data to the Thingspeak cloud.

Experiment-9: Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from the Thingspeak cloud.

Experiment-10 Write a program on Arduino/Raspberry Pi Potentiometer and Ir Sensor Interfacing with Arduino

Experiment-11: Write a program on Arduino/Raspberry Pi to Control Two Actuators by smartphone Using a Bluetooth module.

Part-B

Continuous Internal Evaluation (CIE)

Experiment-1: To get the Arduino to spin a shaft in only one direction using a DC motor

Experiment-2: To control the direction of spin of a DC motor using Arduino UNO and an H Bridge.

Experiment-3: To control the rotation of a servo motor within the range of 0 to 180 degrees with the aid of two switches.

Experiment-4: To measure the flow rate and volume of water using **Water** Flow Sensor with Arduino

Experiment-5: To measure surface temperature using ESP32 microcontroller with Arduino.

Reference Book:

- Arshdeep Bahga, Vijay Madisetti. Internet of Things. Hands on Approach. University Press. 2020

22UBEK407	Biology for Engineers	(1-0-0) 1

Contact Hours: 13

Course Learning Objective (CLO):

1. Gain a fundamental understanding of basic biological concepts and their relevance to engineering applications.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to		**Mapping to POs (1-12) /PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Demonstrate an understanding of the diverse applications of biomolecules.	1	2,3	13
CO-2	Demonstrate an understanding of the architecture and functioning of the brain, eye, and heart as integral systems in the human body.	2,3	1	-
CO-3	Understand the structure, functions, and bioengineering approaches related to the lungs, kidneys, muscular system, and skeletal system.	13	2,3	1
CO-4	Understand nature-inspired materials and mechanisms.	13	2,3	1
CO-5	Understand the latest trends in bioengineering.	2,3	1	13

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	1.8	2.4	2.4	-	-	-	-	-	-	-	-	-	2.0	-	-

Course content:

Unit-I

Biomolecules and their applications: Carbohydrates, Nucleic acids, Proteins, lipids, and Enzymes. **3 Hrs**.

Unit-II

Human organ systems and bio designs - 1: Brain as a CPU system, Eye as a Camera system, Heart as a pump system **3 Hrs.**

Unit-III

Human organ systems and bio-designs - 2: Lungs as purification system, Kidney as a filtration system, Muscular and Skeletal Systems as scaffolds. **2 Hrs.**

Unit-IV

Nature-bioinspired materials and mechanisms: Echolocation, Photosynthesis, Bird flying (GPS and aircrafts), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes. **3 Hrs.**

Unit-V

Trends in bioengineering: Bioprinting techniques and materials, 3D printing of ear, bone, and skin. Electrical tongue and electrical nose in food science, Bioimaging and Artificial Intelligence for disease diagnosis. **2 Hrs.**

Reference Books:

1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
2. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
3. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011. • Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
4. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
5. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016

22UMBA401	Mathematics	(3-0-0) Audit

Contact Hours: 39

Course Learning Objectives (CLOs):

This course will enable students to use Laplace transform to solve differential equations. Analyze and Solve system of linear equation. Understand the concept of vector differentiation and vector integration.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Transform** the given function using Laplace transforms and study their properties.	-	-	1,2
CO-2	**Apply** Laplace transform to solve differential equations.	-	-	1,2
CO-3	**Compute** the solution of system of equations. Evaluate Eigen values and Eigen vectors for a matrix.	-	1,2	-
CO-4	**Study** vector calculus and **compute** gradient, divergence, curl of a single valued function.	-	-	1,2
CO-5	**Study** vector integration and **evaluate** Line integrals, Surface integrals and Volume integrals	-	-	1,2

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	1.2	1.2	-	-	-	-	-	-		-	-	-

Pre-requisites: Knowledge of fundamentals of calculus, Basic Linear Algebra

Course Content:

Unit-I

Laplace Transforms:

Definition and Properties. Laplace transform of elementary functions. Laplace transform of $e^{at}f(t)$ Laplace transform of $t^n f(t)$, Laplace transform of $\frac{f(t)}{t}$, Laplace transforms of Periodic functions and unit-step function–problems. **8 Hrs.**

Unit-II

Inverse Laplace Transforms

Inverse Laplace transform -problems with standard, Convolution theorem (without proof) to find the inverse Laplace transform and problems. Solution of linear differential equations using Laplace transform. **8 Hrs.**

Unit-III

Elementary Linear Algebra:
Rank of a matrix - Row Echelon form. Test for consistency for system of linear equations. Solution of system of linear equations – Gauss-elimination method (consistency), Gauss-Seidel iterative method. Eigen values and Eigen vectors-Rayleigh's power method. **8Hrs.**

Unit-IV

Vector Calculus:-

Vector Differentiation: Scalar point function and vector point functions. Gradient, Directional Derivative; Curl and Divergence-physical interpretation. Solenoidal and irrotational vectors. Illustrative problems. **8Hrs.**

Unit- V

Vector Integration:
Line integrals, Surface integrals and Volume integrals. Green's theorem, Gauss divergence theorem and Stoke's theorem (only statements). **7Hrs.**

Text Books

1. **B.S. Grewal**: Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. **Rajesh Verma & H.K.Dass,** Higher Engineering Mathematics,,3rd edition. 2014.

Note: 1. Grades (i) PP (ii) NP
2. No semester End Examination
3. Audit (Bridge course)

1. The mandatory non–credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B.Tech., programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE.

2. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

22UPYK408	Physical Education and Yoga	(0-0-2) Audit

Contact Hours: 24

Course Learning Objectives:

1. The course focuses on overall development and importance of Physical Education & Yoga in day to day life.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Gaining the importance of Physical Education & yoga	12	--	8, 9
CO2	Understanding the benefits & preventive measures of health	12	6	8, 9
CO3	Gaining the knowledge of yoga	12	--	8, 9
CO4	Understanding the importance of Human Body conditioning & Sports training	12	--	8, 9
CO5	Get awareness of Modern technology in sports	12	--	5, 8, 9

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	-	-	-	-	1	2	-	1	1	-	-	3

Contents

Unit-I

Introduction to Physical Education: Meaning and importance, definition, components, benefits of physical education. **4Hrs**

Unit-II

Health and Wellness, Anatomy and Physiology: Meaning and importance, definition, components, benefits, health habits, basics of diseases and preventive measures, mental health, physical health, social health, spiritual health. Meaning and definition, first aid, injuries and preventions. **5Hrs**

Unit-III

Introduction of Yoga: Origin and history of Yoga, meaning and definition, benefits, importance prayer Suryanamaskara,

Asana:- Ardha chakrasana, Vajrasana, Supta vajrasana, Dhanurasana.

Pranayama:- Surya Anuloma Viloma & Chandra Anuloma Viloma.

Mudras:- Jnana mudra & Vayu mudra. **5Hrs**

Unit-IV

Sports Training: Meaning and definitions, warming up, cooldown, methods of exercises, stretching, speed, endurance, flexibility, agility, Athletics, Table Tennis, Hockey, Cross country, Archery Rules and regulation of all games. **5Hrs**

Unit-V

Modern Technology in Sports and Games: Meaning and definitions, objectives, assisting umpires/ referees, hawk-eye technology, sports specific, computer software, technology in playfields, athletes clothing and equipment, graphics of sports and games, artificial intelligence. **5Hrs**

Reference Books:

1) Petipus, et al., Athlete's Guide to Career Planning, Human Kinetics, 1997
2) The Human Body in Health and Disease with Access 8th Edition 2023.
3) Anatomy and Physiology, Shri K.G. Nadgir College of Physical Education. Dharwad.
4) Health & Wellness Shri K.G. Nadgir College of Physical Education. Dharwad.
5) Nagendra HR., The art and science of Pranayama, 2009
6) Iyengar BKS., The illustrated Light on Yoga(English), 2005

CIE and SEE Evaluation (from 2025-26batch)

Courses with LTP 3-0-0 and 4-0-0 or 2-2-0/3-2-0

Continuous Internal Evaluation (CIE):

- Two Internal Assessment and one Improvement test each of 20 marks and one hour duration.
- Two higher scores from three tests are taken representing 40 marks.
- Question Paper pattern for Internal Assessment: 3 questions of 10 marks each with maximum of two sub divisions. Q.3 is compulsory and one question to be answered from Q.1 and Q.2.
- Course Teacher Assessment (CTA): Minimum two components such as quiz, seminar, written assignment, any technical activity related to course each of 5marks. Total CTA marks-10
- CIE=40 (from tests) +10(from CTA) =50 marks

Semester End Examination (SEE):

- SEE is conducted for100 marks with 3 hours duration. It is reduced to 50 marks.
- Question Paper pattern for SEE: Five units with built in choice. Each question with maximum of three sub divisions.
- Two questions are to be set from each unit with built in choice, for example Q1 or Q2 in unit –I, Q 3 or Q 4 in unit-II and so on.
- A total of 5 full questions to be answered choosing one full question from each unit. All five units are to be answered compulsorily.
- Each question is of 20 marks.
- The Question paper is to be set for duration of 3 hours both for 3 and 4 credits courses.
- The Question paper is to be set for 100 marks for 3 and 4 credits courses.

ASC(IC)/PCC with LTP 2-0-2, 3-0-2 and 2-2-2

Continuous Internal Evaluation (CIE):

Theory CIE component:

- Two Internal Assessment and one Improvement test each of 20 marks and one hour duration.
- Two higher scores from three tests are taken representing 40 marks.
- Question Paper pattern for Internal Assessment: 3 questions of 10 marks each with maximum of two sub divisions. Q.3 is compulsory and one question to be answered from Q.1 and Q.2.

Course Teacher Assessment (CTA): Totally based on conduction of experiments as set by the course teacher.

Laboratory component assessment:

- 5 marks: for conduction, regularity, involvement, journal writing, etc. Minimum 75% of attendance is compulsory. If the performance is not satisfactory in

laboratory the student shall be detained and required to reregister for the course as a whole whenever offered next.

- 5 marks: Lab Test. A Lab test as per the class time table has to be conducted at the end for50 marks and scale down to 5 marks.
- CIE for integrated course =40 (from IA tests)+10 (from CTA i.e. lab component) =50 marks.
- There will not be any remuneration for Final Lab Test since it is CTA of integrated course.
- Copy of the Marks list to be sent to the concerned course instructor immediately after the completion of test for that batch. Original Marks list to be maintained in the department.
- CIE=40(from tests)+10(from CTA i.e. lab component) =50 marks

Semester End Examination (SEE):

- SEE is conducted for100 marks with 3 hours duration. It is reduced to 50 marks.
- Question Paper pattern for SEE: Five units with built in choice. Each question with maximum of three sub divisions.
- Two questions are to be set from each unit with built in choice, for example Q1 or Q2 in unit –I, Q 3 or Q 4 in unit-II and so on.
- A total of 5 full questions to be answered choosing one full question from each unit. All five units are to be answered compulsorily.
- Each question is of 20 marks.
- The Question paper is to be set for duration of 3 hours both for 3 and 4 credits courses.
- The Question paper is to be set for 100 marks for 3 and 4 credits courses.

AEC/HSMS/UHV Courses with LTP 1-0-0:

Continuous Internal Evaluation (CIE)

- Two Internal Assessment and one Improvement test each of 20 marks and one hour duration.
- Two higher scores from three tests are taken representing 40 marks.
- Question Paper pattern for Internal Assessment: MCQ 20 questions
- Course Teacher Assessment (CTA): Minimum two components such as quiz, seminar, written assignment, any technical activity related to course etc. each of 5marks. Total CTA marks-10
- CIE=40(from tests)+10(from CTA) =50 marks

Semester End Examination (SEE):

- SEE is conducted for 50 marks of 1 hour duration. There will be 50 MCQs.
- Question Paper pattern for SEE: The question paper will contain 12 MCQ questions drawn from each Unit.
- Students have to answer maximum of 10 questions from each unit.
- All five units are to be answered compulsorily.

For NSS/Physical Education/Yoga Audit Courses with LTP 0-0-2
Continuous Internal Evaluation (CIE)

- All students have to register for any one course in each semester of III to VI with concerned course instructor.
- The department must make a faculty coordinator for the above audit courses and the details of the students must be maintained.
- The concerned course instructor must define the set of activities and its schedule of the conduction in NSS, PE and Yoga by taking approval from Dean Academic Program.
- The course instructor has to conduct the events as per the schedule and maintain the attendance for the same. 75% attendance is mandatory.
- The course instructor must assess the students by conducting the MCQ test for 50 marks to be conducted during the improvement test for other courses.
- The course instructor must send the marks and attendance register to the respective departments.
- The faculty coordinator of the department must maintain the same and arrange for sending the marks to CoE.