Continuous Internal Evaluation (CIE)
Record Details
2022 Scheme (2023-2027 Batch)

Each Course/Subject has five modules:

- **Module 1**
- **Module 2**
- **Module 3**
- **Module 4**
- **Module 5**

- **50% of the syllabus must be covered before IA – I, and the remaining 50% must be covered before IA – II.**
- **IA – I and IA – II are compulsory for all students. IA – III will be conducted as an improvement test for the syllabus of IA – I or IA – II, as required. If needed, students can attend the improvement tests for both IA – I and IA – II.**

Continuous Internal Evaluation Marks Break-Up

Sl. No.	Particulars	Max. Marks
1.	Internal Assessment (IA) (IA – I and IA – II)	25
2.	Assignment 10	10
3.	Library	05
4.	Attendance	05
5.	Relevant Other Activities (Seminar, Field Work etc)	05
	Total	**50**

Table 01: Internal Assessment Marks

Sl. No.	Particulars	Max. Marks
1.	Internal Assessment – I 50	50
2.	Internal Assessment – II 50	50
3.	Internal Assessment – III (Improvement IA – I)	50
4.	Internal Assessment – III (Improvement IA– II)	50
	Average Marks (IA – I and IA – II)	**50**
Note: Final Average Marks should be reduced to 25		

Table 02: Other Component

Sl. No.	Particulars	Max. Marks
1.	Assignment	10
2.	Library	05
3.	Attendance	05
4.	Other	05
	Average Marks (IA – I and IA – II)	**25**
Note: Final Average Marks should be reduced to 25		

Final Marks = Table 1 + Table 2
Example: Final Marks = 24+23
= 47/50

Sharnbasva University, Kalaburagi
Faculty of Engineering & Technology (Co-Edu.)
Scheme of Teaching and Examination 2022-23
[As Per NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]
(Effective from the academic year 2022-23)

Programme: B.Tech: Energy Engineering

III SEMESTER

Sl. No.	Course Code		Course Title	Teaching Department	Teaching Hours/week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BS	22MATM31	Mathematics for MES-III	Mathematics	3	0	0	3	50	50	100	03
2	PCC	22EG32	Thermodynamics and Energy Conversion	EEG	4	0	0	3	50	50	100	04
3	PCC	22EG33	Mechanics of Materials	EEG	3	0	0	3	50	50	100	03
4	PCC	22EG34	Materials Science for Energy Engineering	EEG	3	0	0	3	50	50	100	03
5	PCC	22EG35	Power Electronics	EEE/EEG	3	0	0	3	50	50	100	03
6	PCC	22EGL36	Energy Conversion Lab -1	EEG	0	0	2	3	50	50	100	01
7	PCC	22EGL37	Material Science and Testing Lab	EEG	0	0	2	3	50	50	100	01
8	PCC	22EGL38	Power Electronics Lab	EEG/EEE	0	0	2	3	50	50	100	01
9	PW	22PRJ39	Project-III	EEG	0	0	2	3	50	50	100	01
10	HSS	22HSM310	Social Connect Responsibility	Humanities	1	0	0	3	50	50	100	01
11	AEC	22AEG311	Ability Enhancement Course-III	EEG	0	0	2	3	50	50	100	01
Total					**17**	**0**	**10**	**33**	**550**	**550**	**1100**	**22**

Note: BS-Basic Science, PCC- Programme Core Course, PW-Project Work, AEC- Ability Enhancement Course, HSS-Humanity and Social Science, NCMC-Non-Credit Mandatory Course.
Project (PRJ): A Batch of 4 students (Same Branch or Different Branches with a Guide, May undertake one project.

Ability Enhancement Course-3												
Course code under 22AEG311X			**Course Title**									
22AEG311			Workshop Practice on Refrigeration and Air Conditioning									
Courses prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs												
12	**NCMC**	**22MATDIP31**	**Additional Mathematics – I**	**Mathematics**	**2**	**-**	**-**	**-**	**100**	**00**	**100**	**00**

1) Non-Credit Mandatory Courses (NCMC) Additional Mathematics-I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of B. Tech. programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the university examination. In case any student fails to register for the said course/fails to secure the minimum 50% of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the students have to fulfill the requirements during subsequent semester/s to appear for SEE.
2) These courses shall not be mandatory for vertical progression, but completion of the courses shall be mandatory for the award of degree.

Courses prescribed to lateral entry B.Sc. degree holders admitted to III semester of Engineering programs

Lateral entry students from B.Sc. stream, shall clear the noncredit courses Computer Aided Engineering Drawing, Elements of Civil Engineering of First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

AICTE Activity Points to be earned by students admitted to B.Tech. programme (For more details refer to Chapter 6, AICTE Activity PointProgramme, Model Internship Guidelines):

Over and above the academic grades, every regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other universities to fifth semester are required to earn 50 activity points from the year of entry to Sharnbasva University. The- Activity Points earned shall be reflected on the students eighth semester Grade card.

The activities can be spread over the years, anytime during the semester weekends holidays, as per the liking and convenience of the student fromthe year of entry to the programme. However, minimum hours requirement should be fulfilled. Activity Points (Non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.

In case students fail to earn the prescribed activity points, eighth semester Grade Card shall be issued only after earning the required activity points. Student shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

MATHEMATICS FOR MECHANICAL ENGINEERING STREAM-III

Semester: III

Course	Code	Credits	Total Hours - 45 Hours/Week		Assessment		Exam Duration in Hours
			Lecture	Tutorial	SEE	CIE	
Mathematic for MES -III	22MATM31	03	03	00	50	50	03

COURSE OBJECTIVES:

The goal of the course Mathematics for Mechanical Engineering Stream-III (22MATM31) is to

1. Familiarize the importance of Random variable and Probability distribution essential for Mechanical engineering.
2. Analyze Civil engineering problems applying Statistical methods to fit a curve and understand co-variance of two variables and its correlation coefficient.
3. Develop the knowledge of complex variable and find the Analyticity of a function.
4. Apply LPP in real life example.
5. To develop the knowledge of functionals and variational problems.
6. Develop the knowledge of solving Mechanical engineering problems numerically.

MODULE-1

Probability Distribution: Random variables (discrete and continuous) probability mass/density functions. Binomial distribution, Poisson distribution. Exponential and Normal distributions. Problems.

Self-Study: Definition of probability, addition and multiplication rule, Bay's theorem.

09 Hours

MODULE-2

Basic Statistics: Measures of central tendency, measures of dispersion, range quartile deviation, mean deviation, standard deviation, coefficient of variation, Skewness and Kurtosis, problems.

Statistical Methods: Correlation-karl Pearson's co-efficient of correlation problems. Regression analysis lines of regression, Rank correlation (without proof)-problems.

Curve Fitting: Curve fitting by the method of least square. Fitting of the curves of the form $y = ax + b$, $y = ax^2 + bx + c$ & $y = ae^{bx}$.

Self-study: Center and circle of curvature, evolutes and involutes. **09 Hours**

MODULE-3

Complex variable-1: Complex valued function, limit, continuity, differentiability, analytic functions. Cauchy-Riemann Equation in Cartesian, Polar form. Harmonic and orthogonal property and problems on construction of Analytic function.

Self-Study: Complex Trigonometry. **09 Hours**

MODULE-4

Calculus of variation: Functional; Variation of a functional and its properties; Variational problems with fixed boundaries; Euler's equation, Extremals; Functional dependent on several unknown functions and their first order derivatives; Functionals dependent on higher order derivatives; Functionals dependent on the function of more than one independent variable; Variational problems in parametric form;

Self-Study: Differential equation with more than variable. **09 Hours**

MODULE-5

Operation Research: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and Two-Phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.

Self-Study: Formulation of LPP **09 Hours**

COURSE OUTCOMES:

CO#	Course Outcomes
C01	Knowing the random variable both discrete and continuous and their probability distribution, Mass density function and solving the problems on various engineering problems.
C02	Apply the concept of correlation and regression lines for solving the problems and numerical techniques to solve engineering problems and fit a least squares curve to the given data.
C03	Apply the knowledge of Fourier transform to solve engineering problems. Understand the analyticity, potential fields, residues and poles of complex potentials in field theory, electromagnetic theory and studying Bilinear transformation.
C04	Understand what functionals are, and have some appreciation of their applications
C05	Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2		1				1			1
CO2	3	2	2		1				1			1
CO3	3	2	2		1				1			1
CO4	3	2	2		1				1			1
CO5	3	2	2		1				1			1

TEXT BOOKS:

1. B.S.Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.,2021.
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

REFERENCE BOOKS:

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.,2017
2. **Srimanta Pal & Subodh C. Bhunia**: "Engineering Mathematics" Oxford University Press, 3rdEd., 2016.
3. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications,10th Ed.,2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw–Hill Book Co, New York, 6thEd., 2017.
5. **Gupta C. B, Sing S. Rand Mukesh Kumar:** "Engineering Mathematic for Semester I

and II", Mc-Graw Hill Education (India)Pvt. Ltd 2015.
6. **H.K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rdEd. ,2014
7. **James Stewart: "**Calculus" CengagePublications,7thEd.,2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers,4th Ed.,2018
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6thEd., 2017.

SCHEME OF EXAMINATION:

Two questions to be set from each module. Students have to answer five full questions choosing at least one full question from each module.

THERMODYNAMICS AND ENERGY CONVERSIONS

Semester: III

Course	Code	Credits	Total Hours - 50 Hours/Week		Assessment		Exam Duration in Hours
			Lecture	Tutorial	SEE	CIE	
Thermodynamics and Energy Conversions	22EG32	04	04	00	50	50	03

COURSE OBJECTIVES:

1) To introduce about basic concepts of Zeroth law, temperature scales and work and heat interaction.
2) To explicate the First and Second law of thermodynamics.
3) To illuminate the concepts of Entropy and Pure substances.
4) To elucidate the concepts of Gas power cycles and Vapour power cycles.
5) To study the basics of Refrigeration and Compressors.

MODULE-1

Basic concepts, Zeroth law and temperature:

Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive, extensive properties, specific properties, pressure, specific volume Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics, Temperature; concepts, scales, international fixed points and measurement of temperature. Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer.

Energy Interaction:

Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention. Problems. **10 Hours**

MODULE-2

First Law of Thermodynamics:

Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, Extension of the First law to control volume; steady flow energy equation (SFEE), important applications.

Second Law of Thermodynamics:

limitations of first law of thermodynamics, Devices converting heat to work (Heat engine); Devices converting work to heat (Reversed Heat engine). Second law thermodynamics statements Kelvin - Planck statement and Clausius statement, Equivalence of the two statements; perpetual motion machine of second kind, Carnot cycle, Carnot principles. Numerical. **10 Hours**

MODULE-3

Entropy:

Introduction, Clausius theorem, entropy a property of system, Clausius inequality, two reversible adiabatic path cannot intersect each other, Carnot's cycle on temperature-entropy diagram, change in entropy in an irreversible process, principle of increase of entropy, numerical.

Pure Substances:

P-V-T surface for a pure substance, 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, Dryness fraction, T-S and H-S diagrams of various processes. Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter. **10 Hours**

MODULE-4

Gas Power cycles:

Carnot, Stirling, Brayton, Otto, Diesel and Dual cycles, Numerical.

Vapour power cycles:

Simple steam cycle, Rankine cycle, actual vapour cycle processes, comparison of Carnot and Rankine cycle, reheat and regeneration cycle and numerical. **10 Hours**

MODULE-5

Refrigeration:

Definition, refrigeration effect, co-efficient of performance, ton of refrigeration, applications, desirable properties of good refrigerants, Reversed heat engine cycle, vapour compression refrigeration system, vapour absorption refrigeration system, change in operating conditions on the performance of vapour compression and simple numerical.

Compressors:

Introduction, working of reciprocating air compressor, air compressor terminology, work done by compressor with and without clearance, isothermal efficiency, volumetric efficiency, multi stage compressor, condition for minimum work, numerical problems. **10 Hours**

COURSE OUTCOMES

At the end of this course, student will be able to

CO#	COURSE OUTCOMES
CO1	Know the basic concepts of Zeroth law, temperature scales and work and heat interaction.
CO2	Practice the examples on First and Second law of thermodynamics and their applications.
CO3	Concepts of Entropy and Pure substances
CO4	Analyse the Gas power cycles and Vapour power cycles.
CO5	Apply and analyse the basics of Refrigeration and Compressors.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	03	02		02	01			01				01
CO2	03	02		02	01			01				01
CO3	03	02		02	01			01				01
CO4	03	02		01	01			01				01
CO5	03	02		01	01			01				01

TEXT BOOKS:

1) Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000
2) Kothandaraman.C.P, Domkundwar. S,Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition," Dhanpat Rai & sons, 2002

REFERENCES:

1) Basic and Applied Thermodynamics by P.K. Nag, MCGRAW HILL INDIA
2) Steam & Gas Turbine by R. Yadav, CPH Allahabad
3) Thermal Engg. By PL Ballaney, Khanna Publisher
4) Ganesan V." Internal Combustion Engines", Third Edition, Tata McGraw-Hill 2007
5) Thermodynamics: An Engineering Approach (SIE) By Yunus A. Cengel, Michael A. Boles, Mehmet Kanoglu , 2019 Publisher MCGRAW HILL INDIA.

SCHEME OF EXAMINATION:

Two questions to be set from each module. Students have to answer five full questions choosing at least one full question from each module.

MECHANICS OF MATERIALS

Semester: III

Course	Code	Credits	Total Hours - 45 Hours/Week		Assessment		Exam Duration in Hours
			Lecture	Tutorial	SEE	CIE	
Mechanics of Materials	22EG33	03	03	00	50	50	03

COURSE OBJECTIVES:

1) To understand the basic concepts of the stresses and strains for different materials and strength of structural elements.
2) To know the development of internal forces and resistance mechanism for one dimensional and two-dimensional structural elements.
3) To analyses and understand different internal forces and stresses induced due to representative loads on structural elements.
4) To analyses and understand principal stresses due to the combination of two-dimensional stresses on an element and failure mechanisms in materials.
5) To evaluate the behavior of torsional members, columns and struts.

MODULE-1

Stresses and Strains:

Introduction, Properties of materials, Stress, Strain and Hooke's law, Stress strain diagram for brittle and ductile materials, True stress and strain, Calculation of stresses in straight, Stepped and tapered sections.

Composite sections, Stresses due to temperature change, Shear stress and strain, Lateral strain and Poisson's ratio, Elastic constants and relations between them, numerical.

09 hours

MODULE-2

Analysis of Stress and Strain:

Introduction to three-dimensional state of stress, Stresses on inclined planes, Principal stresses and maximum shear stress.

Principal angles, Shear stresses on principal planes, Maximum shear stress, Mohr circle for plane stress conditions. **09 hours**

MODULE-3

Shear Force and Bending Moment in Beams:

Introduction to types of beams, supports and loadings. Definition of bending moment and shear force, Sign conventions, relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beams subjected to points load, uniformly distributed loads, uniformly varying loads, couple and their combinations.

09 hours

MODULE-4

Bending and Shear Stresses in Beams:

Introduction, pure bending theory, Assumptions, derivation of bending equation, modulus of rupture, section modulus, flexural rigidity. Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections. Shear

Centre (only concept).

Thin and Thick Cylinders:

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

09 hours

MODULE-5

Torsion in Circular Shaft:

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

Theories of Failure:

Introduction, maximum principal stress theory (Rankine's theory), Maximum shearing stress theory (Tresca's theory), Strain energy theory (Beltrami and Haigh), and maximum strain theory (St. Venant's theory). **09 hours**

COURSE OUTCOMES

At the end of this course, student should be able to

CO#	COURSE OUTCOMES
CO1	Study simple, compound, thermal stresses and strains their relations and strain energy.
CO2	Analyse structural members for stresses, strains and deformations.
CO3	Analyse the structural members subjected to bending and shear loads.
CO4	Comprehend the basic concept of analysis and design of members, subjected to bending and understand the concept of cylinders.
CO5	Comprehend the basic concept of analysis and design of members subjected to torsion and thus understand failure concepts

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	03	02				02		01				02
CO2	03	02				02		01				02
CO3	03	02				02		01				02
CO4	03	02				02		01				02
CO5	03	02				02		01				02

TEXT BOOKS:

1. B.S. Basavarajaiah, P.Mahadevappa "Strength of Materials" in SI Units, University Press (India) Pvt. Ltd., 3rd Edition, 2010
2. Ferdinand P. Beer, E. Russell Johnston and Jr.John T. DeWolf "Mechanics of Materials", Tata McGraw-Hill, Third Edition, SI Units.

REFERENCES:

1) D.H. Young, S.P. Timoshenko "Elements of Strength of Materials" East West Press Pvt. Ltd., 5th Edition (Reprint 2014)
2) R K Bansal, "A Textbook of Strength of Materials", 4th Edition, Laxmi Publications, 2010

3) S.S. Rattan "Strength of Materials" McGraw Hill Education (India) Pvt. Ltd., 2nd Edition (Sixth reprint 2013)
4) Fundamentals of Strength of Materials P N Chandramouli PHI Learning Pvt. Ltd 2013
5) Strength of Materials R K Rajput S. Chand and Company Pvt. Ltd 2014
6) Strength of Materials R. Subramanian Oxford 2005

SCHEME OF EXAMINATION:

Two questions to be set from each module. Students have to answer five full questions choosing at least one full question from each module.

MATERIALS SCIENCE FOR ENERGY ENGINEERING

Semester: III

Course	Code	Credits	Total Hours - 45 Hours/Week		Assessment		Exam Duration in Hours
			Lecture	Tutorial	SEE	CIE	
Material Science for Energy Engineering	22EG34	03	03	00	50	50	03

COURSE OBJECTIVES:

Upon successful completion of the course the students will be familiar with

1. Provide basic background to systematically approach for selection of materials for a wide range of products in engineering applications.
2. Introduce the concept of crystal structure, atomic planes and directions.
3. Introduce the concept of atomic packing, coordination, and symmetry elements.
4. Introduce imperfections in solids.
5. Introduce phase stabilities and phase diagrams.
6. Teach mechanism of phase transformations.
7. Introduce various heat treatment methods.

MODULE-1

Structure of Materials:

Introduction: Classification of materials, crystalline and non-crystalline solids, atomic bonding

Geometrical Crystallography: Symmetry elements: the operation of rotation, Proper and Improper rotation axes, Screw axes, Glide planes.

Crystal Structure: Crystal Lattice, Unit Cell, Planes and directions in a lattice, Planar Atomic Density, packing of atoms and packing fraction, Classification and Coordination of voids, Bragg's Law

Imperfections in Solids: Types of imperfections, Point defects: vacancies, interstitials, line defects, 2-D and 3D-defects, Concept of free volume in amorphous solids. **09 Hours**

MODULE-2

Physical Metallurgy:

Alloy Systems: Classification of Solid solutions, Hume- Rothery Rules

Phase Diagrams: Gibbs Phase Rule, Solubility limit, phase equilibria and Phase Diagrams: Isomorphous systems, Invariant Binary Reactions, Lever Rule; important phase- diagrams, Iron-Carbon Diagram.

Diffusion: Diffusion-Fick's Laws, Role of imperfections in diffusion **09 Hours**

MODULE-3

Nucleation and growth: Introduction to homogeneous and heterogeneous nucleation, critical radius for nucleation.

Plastic Deformation: Slip, Twinning; Recovery- Recrystallization-Grain Growth, Introduction to Strengthening mechanisms. Lever rule and phase diagram.

Heat treatment: Annealing, Normalizing, hardening, Tempering, Nitriding, Cyaniding, Induction Hardening and Flame Hardening, Recent advances in heat treat technology. TTT diagram, microstructural effects brought about by these processes and their influence on mechanical properties **09 Hours**

MODULE-4

Surface coating technologies: Introduction, coating materials, coating technologies, types of coating, advantages and disadvantages of surface coating.

Powder metallurgy: Introduction, Powder Production Techniques: Different Mechanical and Chemical methods, Characterization of powders (Particle Size & Shape Distribution), Powder Shaping: Particle Packing Modifications, Lubricants & Binders, Powder Compaction & Process, Sintering and Application of Powder Metallurgy. **09 Hours**

MODULE-5

Nanomaterials Applied in Solar Cells: Nano, micro, and poly crystalline and amorphous Si for solar cells, Nano-micro-Si-composite structure, various techniques of Si deposition. Nanostructured Materials for High Efficiency Perovskite Solar Cells, Dielectric Nanomaterials for Silicon Solar Cells, Nanostructured Cathode Buffer Layers for Inverted Polymer Solar Cells - Discotic Liquid Crystals for Self-organizing Photovoltaics. **09 Hours**

COURSE OUTCOMES

At the end of this course, student should be able to

CO#	COURSE OUTCOMES
CO1	Understand the atomic arrangement in crystalline materials and describe the periodic arrangement of atoms in terms of unit cell parameters.
CO2	Understand the importance of phase diagrams and the phase transformations.
CO3	Know various heat treatment methods for controlling the microstructure.
CO4	Correlate between material properties with component design and identify various kinds of defects.
CO5	Apply the method of materials selection, material data and knowledge sources for computer-aided selection of material

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2			2	1						1
CO2	3	2			2	1						1
CO3	3	2			2	1						1
CO4	3	2			2	1						1
CO5	3	2			2	1						1

TEXT BOOKS:

1. Ashby, M.F. (2010), Materials Selection in Mechanical Design, 4th Edition, Butterworth-Heinemann.
2. Azaroff, L.V., (2001) Introduction to solids, 1st Edition, McGraw Hill Book Company.
3. Avner, S.H., (2017), Introduction to Physical Metallurgy, 2nd Edition, McGraw Hill Education.
4. Powder Metallurgy Technology, Cambridge International Science Publishing,2002.

REFERENCES:

1. Jones, D.R.H., and Ashby,M.F., (2011), Engineering Materials 1: An Introduction to Properties, Application and Design, 4th Edition, Butterworth-Heinemann.
2. Jones, D.R.H., and Ashby,M.F., (2012), Engineering Materials 2: An Introduction to Microstructure and Processing, 4th Edition, Butterworth-Heinemann.
3. Callister Jr, W.D., Rethwisch, D.G., (2018), Materials Science and Engineering: An Introduction, 10th Edition, Hoboken, NJ: Wiley.
4. Abbaschian, R., Abbaschian, L., Reed-Hill, R. E., (2009), Physical Metallurgy Principles, 4t Edition, Cengate Learning.
5. P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI, New Delhi,2008

SCHEME OF EXAMINATION:

Two questions to be set from each module. Students have to answer five full questions choosing at least one full question from each module.

POWER ELECTRONICS

Semester: III

Course	Code	Credits	Total Hours - 45 Hours/Week		Assessment		Exam Duration in Hours
			Lecture	Tutorial	SEE	CIE	
Power Electronics	**22EG35**	**03**	**03**	**00**	**50**	**50**	**03**

COURSE OBJECTIVES:

Upon successful completion of the course the students will be familiar with

1. To understand the applications power electronics, different types of power semiconductor devices, their switching characteristics, power diode characteristics, types, their operation and the effects of power diodes on RL circuits.
2. To comprehend the techniques for design and analysis of single-phase diode rectifier circuits.
3. To analyse the different power transistors, their steady state and switching characteristics and limitations.
4. To know the different power transistors, their steady state and switching characteristics and limitations.
5. To understand and analyse the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and Voltage controllers.

MODULE-1

Introduction: Applications of Power Electronics, Types of Power Electronic Circuits, Peripheral Effects, Characteristics and Specifications of Switches.

Power Diodes: Introduction, Diode Characteristics, Reverse Recovery Characteristics, Power Diode Types, Silicon Carbide Diodes, Silicon Carbide Schottky Diodes, Freewheeling diodes, Free wheeling diodes with RL load.

Diode Rectifiers: Introduction, Diode Circuits with DC Source connected to R and RL load, Single-Phase Full-Wave Rectifiers with R load, Single-Phase Full-Wave Rectifier with RL Load.

09 Hours

MODULE-2

Power Transistors: Introduction, Power MOSFETs – Steady State Characteristics, Switching Characteristics Bipolar Junction Transistors – Steady State Characteristics, Switching Characteristics, Switching Limits, IGBTs, MOSFET Gate Drive, BJT Base Drive, Isolation of Gate and Base Drives, Pulse transformers and Opto-couplers. **09 Hours**

MODULE-3

Thyristors: Introduction, Thyristor Characteristics, Two-Transistor Model of Thyristor, Thyristor Turn- On, Thyristor Turn-Off, A brief study on Thyristor Types, Series Operation of Thyristors, Parallel Operation of Thyristors, di/dtProtection, dv/dtProtection, DIACs, Thyristor Firing Circuits, Unijunction Transistor. **09 Hours**

MODULE-4

Controlled Rectifiers: Introduction, Single phase half wave circuit with RL Load, Single phase half wave circuit with RL Load and Freewheeling Diode, Single phase half wave circuit with RLE Load, Single-Phase Full Converters with RLE Load, Single-Phase Dual Converters, Principle of operation of Three- Phase dual Converters.

AC Voltage Controllers: Introduction, Principle of phase control & Integral cycle control, Single-Phase Full-Wave Controllers with Resistive Loads, Single- Phase Full-Wave Controllers with Inductive Loads, Three-Phase Full-Wave Controllers. **09 Hours**

MODULE-5

DC-DC Converters: Introduction, principle of step down and step-up chopper with RL load, performance parameters, DC-DC converter classification.

DC-AC Converters: Introduction, principle of operation single phase bridge inverters, three phase bridge inverters, voltage control of single-phase inverters, Harmonic reductions, Current source inverters. **09 Hours**

COURSE OUTCOMES:

At the end of this course, student should be able to

CO#	COURSE OUTCOMES
CO1	Overview of applications power electronics, different types of power semiconductor devices, their switching characteristics, power diode characteristics, types, their operation and the effects of power diodes on RL circuits.
CO2	Analyse techniques for design and analysis of single-phase diode rectifier circuits.
CO3	Explain different power transistors, their steady state and switching characteristics and limitations.
CO4	Know the types of Thyristors, their gate characteristics and gate control requirements.
CO5	Analysis techniques, performance parameters and characteristics of controlled rectifiers, DC-DC, DC -AC converters and Voltage controllers

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1			1						1
CO2	3	2	1			1						2
CO3	3	1	1			1						1
CO4	3	2	1			2						1
CO5	3	2	1			1						1

TEXT BOOKS:

1. Power Electronics: Circuits Devices and Applications Mohammad H Rashid, Pearson 4th Edition, 2014

REFERENCES:

1. Power Electronics P.S. Bimbhra Khanna Publishers 5th Edition, 2012
2. Power Electronics: Converters, Applications and Design Ned Mohan et al Wiley 3rd Edition, 2014
3. Power Electronics Daniel W Hart McGraw Hill 1st Edition, 2011
4. Elements of Power Electronics Philip T Krein Oxford Indian Edition, 2008

SCHEME OF EXAMINATION:

Two questions to be set from each module. Students have to answer five full questions choosing at least one full question from each module.

ENERGY CONVERSION LAB - 1

Semester: III

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Practical	SEE	CIE	
Energy Conversion Lab -1	**22EGL36**	**01**	**00**	**03**	**50**	**50**	**03**

OBJECTIVES:

Upon successful completion of this laboratory, the students should be able to have hands on experience in

1) Determination of Fire and flash point of various fuels.
2) Determination of viscosity of various fuels.
3) Determination of cloud and pour point of various fuels.
4) Determination of carbon residue of various fuels.
5) Determination of density, calorific value of various fuels.
6) Determination of area of irregular shapes.

PART-A

1. Determination of Flash and Fire point of lubricating oil using Abel Pensky and Marten's (closed) Apparatus.
2. Determination of Flash and Fire point of lubricating oil using Cleveland's (Open Cup) Apparatus.
3. Determination of Calorific value of solid and liquid fuels using Bomb Calorimeter.
4. Determination of Calorific value of gaseous fuels using Boy's gas calorimeter.
5. Determination of Viscosity of a lubricating oil using Redwoods Viscometers.

PART-B

1. Determination of Viscosity of a lubricating oil using Say Bolt Viscometers
2. Determine the carbon residue of the given sample of lubricating oil/ fuels.
3. Determination of cloud point and pour point of the given lubricant.
4. Determination of density of given fluid.
5. Determination of dropping point of a grease.

COURSE OUTCOMES

At the end of this course, student should be able to:

CO#	COURSE OUTCOMES
CO1	Perform experiments to determine the flash point, fire point of fuels and oils.
CO2	Perform experiments to determine calorific value of solid, liquid and gaseous fuels.
CO3	Perform experiments to determine viscosity of various oils.
CO4	Perform experiments to determine carbon residue and density of fuels.
CO5	Perform experiments to determine cloud and pour point of lubricants.
CO6	Perform experiments to determine area of irregular surfaces using planimeter

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1					1	1				1
CO2	1	1					1	1				1
CO3	1	1					1	1				1
CO4	1	1					1	1				1
CO5	1	1					1	1				1
CO6	1	1					1	1				1

Scheme of Examination:

ONE question from par –A: 20 Marks
ONE question from part –B: 20Marks
Viva -Voice: : 10 Marks
Total: : 50 Marks

MATERIAL SCIENCE AND TESTING LAB

Semester: III

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Practical	SEE	CIE	
Material Science and Testing Lab	**22EGL37**	**01**	**00**	**03**	**50**	**50**	**03**

OBJECTIVES:

1. To learn the concept of the preparation of samples to perform characterization such as microstructure, volume fraction of phases and grain size.
2. Calculate the various Mechanical properties of material such as tension, flexural, compression strength and hardness.
3. To learn materials failure modes and the differential loads causing failure.
4. To learn the concept of improving the mechanical properties of materials by differential method like heat treatment, surface treatment etc.

PART-A

1. Preparation of specimen for metallographic examination of different engineering materials. To report microstructure of Plain Carbon Steel, Tool steel, Gray CI, SG Iron. Brass, Bronze and Composites.
2. Brinell Hardness test on metals.
3. Rockwell Hardness test on metals.
4. Vickers's Hardness test on metals.

PART-B

1. Tensile, shear and compression tests of metallic and wooden materials specimens using universal testing machine
2. Bending test on wooden specimen
3. Torsion test on steel bar
4. Izod and Charpy test on mild steel specimen
5. Fatigue test

COURSE OUTCOMES:

At the end of this course, student should be able to:

CO#	COURSE OUTCOMES
CO1	Demonstrate the application of metallography and material science.
CO2	Select the standard experiments to determine the mechanical properties of different materials using hardness test by different apparatus.
CO3	Select the standard experiments to determine tensile, shear and compression tests of various material using UTM.
CO4	Determine the mechanical properties of different materials using torsion test on steel bar.
CO5	Determine the mechanical properties of fatigue test.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		2		2		1				2
CO2	3	3		2		2		1				2
CO3	3	3		2		2		1				2
CO4	3	3		2		2		1				2
CO5	3	3		2		2		1				2

Scheme of Examination:

ONE question from par –A: 15 Marks
ONE question from part –B: 25Marks
Viva -Voice: : 10 Marks
Total: : 50 Marks

POWER ELECTRONICS LAB

Semester: III

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Practical	SEE	CIE	
Power Electronic Lab	**22EGL38**	**01**	**00**	**03**	**50**	**50**	**03**

COURSE OBJECTIVES:

Upon successful completion of this laboratory, the students should be able to have hands on experience in

1) Study Characteristics of power electronic devices.
2) Understand the converters with different Loads
3) Control the speed of different motors.

PART-A

1. Study of Characteristics of SCR,
2. Study of Characteristics of MOSFET
3. Study of Characteristics of IGBT
4. Study of Characteristics of Triac
5. Single Phase Half controlled converter with R load

PART-B

1. Single Phase fully controlled bridge converter with R and RL loads
2. Single Phase AC Voltage Controller with R and RL Loads
3. Speed control of DC motor using single semi converter.
4. Speed control of stepper motor.
5. Speed control of universal motor using ac voltage regulator.

COURSE OUTCOMES:

At the end of this course, student will be able to

CO#	COURSE OUTCOMES
CO1	Study characteristics of different power electronic devices.
CO2	Verify the performance of single phase controlled full wave rectifier with different Loads
CO3	Verify AC voltage controller with R and RL loads.
CO4	Control the speed of a DC motor, universal motor and stepper motors.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-					1		1
CO2	3	2	1	1		1	1					1
CO3	3	2	1	1				1				1
CO4	3	2	1	1	2							1

Scheme of Examination:

ONE question from par –A: 15 Marks
ONE question from part –B: 25Marks
Viva -Voice: : 10 Marks
Total: : 50 Marks

PROJECT-III

Semester: III

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Project	SEE	CIE	
Project-III	**22PRJ39**	**01**	**00**	**02**	**50**	**50**	**03**

OBJECTIVES:

To Introduce fundamental concepts and analysis techniques in engineering to students across all disciplines.

Mini-Project Work:

Based on the ability/abilities of the students and recommendations of the mentor, a single discipline or a multidisciplinary Mini-Project can be assigned to an individual student or to a group having not more than 4 students.

COURSE OUTCOMES:

At the end of this course, student should be able to:

CO#	COURSE OUTCOMES
CO1	Comprehend how to identify issues related to environment, society and industry.
CO2	Able to prepare the model and report on society, environment and industry related projects.
	Total Number Lecture Hours
	NOTE: All levels mentioned are as per Revised Bloom's Taxonomy

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2		1	2	2	1	2	1	1	1
CO2	2	2	2		1	2	2	1	2	1	1	1

Scheme of Examination:

Write-up : 15 Marks
Demonstration : 25Marks
Viva -Voice: : 10 Marks
Total: : 50 Marks

SOCIAL CONNECT RESPONSIBILITY

Semester: III

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Practical	SEE	CIE	
Social Connect Responsibility	**22HSM310**	**01**	**00**	**01**	**50**	**50**	**03**

COURSE OBJECTIVES:

1. Enable the student to do a deep drive into societal challenges being addressed by NGO(s), social enterprises & The government and build solutions to alleviate these complex social problems through immersion, design & technology.
2. Provide a formal platform for students to communicate and connect with their surroundings.
3. Enable to create of a responsible connection with society.

MODULE 1

Plantation and adoption of a tree: Plantation of a tree that will be adopted for four years by a group of B.Tech. students. They will also make an excerpt either as a documentary or a photoblog describing the plant's origin, its usage in daily life, and its appearance in folklore and literature.

03 Hours

MODULE 2

Heritage walks and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photoblog and documentary on evolution and practice of various craft forms. **03 Hours**

MODULE 3

Organic farming and waste management: usefulness of organic farming, wet waste management in neighbouring villages, and implementation in the campus. **03 Hours**

MODULE 4

Water Conservation: knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices.

03 Hours

MODULE 5

Food Walk City's culinary practices, food lore, and indigenous materials of the region used in cooking. **03 Hours**

COURSE OUTCOMES

At the end of this course, student should be able to:

CO#	COURSE OUTCOMES
CO1	Analyse social responsibility
CO2	Practice sustainability and creativity
CO3	Showcase planning and organizational skills

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2			1	1	1				1	1
CO2	3	2			1	1	1				1	1
CO3	3	2			1	1	1				1	1
CO4	3	2			1	1	1				1	1
CO5	3	2			1	1	1				1	1

Semester End Examination (SEE) This Jamming session will be conducted at the end of the course for 50 marks Jamming session includes -Platform to connect to others. Share the stories with others. Share the experience of Social Connect. Exhibit the talent like playing instruments, singing, one-act play, art painting, and fine art. Faculty mentor has to design the evaluation system for the Jamming session.

WORKSHOP PRACTICE ON REFRIGERATION AND AIR CONDITIONING

Semester: III

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Practical	SEE	CIE	
Workshop Practice on Refrigeration and Air Conditioning	**22AEG311**	**01**	**00**	**01**	**50**	**50**	**03**

OBJECTIVES:

The main objectives are to

1) Identify hazards and safety procedures following safety precautions.
2) Identify RAC tools and equipment and recognise different parts of RAC system.
3) Perform copper tube cutting, flaring, swaging and brazing.
4) Test mechanical & electrical components.
5) Perform leak test, vacuuming, gas charging, wiring & installation of refrigerator.
6) Understand the function of compressor, condenser, expansion valve and evaporator.

RAC Work:

Introduction to RAC, Study and Identify the RAC tools and equipment, study on simple vapour compression refrigeration system, study on vapour absorption refrigeration system, study of household/domestic refrigerator, Air conditioning system, Cascade refrigeration, Air conditioning System, study of leak detection and charging procedure for refrigerant and study of refrigeration controls used in refrigeration and air conditioning.

COURSE OUTCOMES

At the end of this course, student should be able to:

CO#	COURSE OUTCOMES
CO1	Study the safety hazards, precautions, RAC Tools, Copper tube cutting and Brazing.
CO2	Analyse the mechanical, electrical, leak test, charging and installation of refrigerator.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2		1	2	2	1	2	1	1	1
CO2	2	2	2		1	2	2	1	2	1	1	1

Scheme of Examination:

Write-up : 15 Marks
Demonstration : 25Marks
Viva -Voice: : 10 Marks
Total: : 50 Marks

ADDITIONAL MATHEMATICS-1

Semester: III

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Practical	SEE	CIE	
Additional Mathematics-1	22MATDIP31	00	02	00	-	50	03

OBJECTIVE:

1. Acquire basic concepts of complex trigonometry, vector algebra, differential and integr calculus and vector differentiation.
2. know the basic concepts of derivatives and representation of different types of polar curves Evaluation of double and triple integrals.
3. know the basic concepts of partial differential equations.
4. To develop the knowledge of matrices and linear algebra in compressive manner.
5. To understand the essential concept of linear algebra.

MODULE 1 : COMPLEX TRIGONOMETRY

Complex Numbers: Definition and Properties. Modulus and Amplitude of complex number, Argand's diagram, De-Moivre's theorem (without proof)

Vector Analysis: Scalar and Vectors. Vector addition and subtraction. Multiplication of vectors (Dot and Cross products) Scalar and vector triple products- simple problems, Vector Differentiation: Gradient, Divergence and Curl. **05 Hours**

MODULE 2: DIFFERENTIAL CALCULUS

Review of successive differentiation. Formulae of nth derivatives of standard functions- Leibnitz's theorem (without proof).

Polar Curves: Expression for Angle between radius vector and tangent, length of perpendicular from pole to the tangent, angle between two polar curves, Pedal Equation of polar curves and problems. Taylor' and Maclaurin's series expansions. **05 Hours**

MODULE 3: PARTIAL DIFFERENTIAL

Definitions of Partial Differentiation, Direct and Indirect partial derivatives, Symmetric functions, Homogeneous function and Euler's theorem on homogeneous function. Total Derivative of composite and implicit function. Jacobians. **05 Hours**

MODULE-4: INTEGRAL CALCULUS

Reduction Formulae of $\int_0^{\pi/2} Sin^n x\, dx, \int_0^{\pi/2} Cos^n x\, dx$, *and* Statement of Reduction formulae $\int_0^{\pi/2} sin^m x\, cos^n x\, dx$ and Problems. Double and Triple integral- simple problems. **05 Hours**

MODULE-5: LINEAR ALGEBRA

Basic concepts of matrices- Rank of matrix by elementary row transformations- Echelon form. Consistency of system of Linear equations. Solution of system linear equations by Gauss Elimination method, Linear Transformation, Cayley- Hamilton theorem to compute inverse of matrix. Eigen values and Eigen vector, Largest Eigen value and corresponding Eigen vector by Reyleigh's Power method. **05 Hours**

COURSE OUTCOMES

At the end of this course, student should be able to

CO#	COURSE OUTCOMES
CO1	Learn the representation of complex numbers in Argand diagram and understanding the vector dot product and cross product and use in finding the area, projection, etc. Also understanding the gradient, divergence and curl operators.
CO2	Apply the knowledge of calculus to find the nth derivative and solve the problems related to polar curves and its applications in determining the bendness of a curve.
CO3	Learn the notion of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions and solve first order linear/nonlinear differential equation analytically using standard methods.
CO4	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.
CO5	Make use of matrix theory for solving system of linear equations and compute Eigen values and Eigen vectors.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2		1				1			1
CO2	3	2	2		1				1			1
CO3	3	2	2		1				1			1
CO4	3	2	2		1				1			1
CO5	3	2	2		1				1			1

TEACHING LEARNING PROCESS:

CIE + Assignments: 15+35=50 Marks

There will be a 2 CIE's, the best one among 2 CIE's will be considered and there will be 35 marks for Assignments

TEXT BOOKS:

1. B.S. Grewal : Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
2. E. Kreyszig : Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.

REFERENCE BOOKS:

1. C.Ray Wylie, Louis C.Barrett : "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Book Co., New York, 1995.
2. James Stewart : "Calculus –Early Transcendentals", Cengage Learning India Private Ltd., 2017.
3. B.V.Ramana : "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. Srimanta Pal & Subobh C Bhunia:"Engineering Mathematics", Oxford University Press,3rd Reprint,2016.
5. Gupta C.B., Singh S.R. and Mukesh Kumar : "Engineering Mathematics for Semester I & II", Mc-Graw Hill Education (India) Pvt.Ltd., 2015.

Sharnbasva University, Kalaburagi
Faculty of Engineering & Technology (Co-Edu.)
Scheme of Teaching and Examination 2022-23
[As Per NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]
(Effective from the academic year 2022-23)

Programme: B.Tech: Energy Engineering

IV SEMESTER

Sl. No.	Course Code		Course Title	Teaching Department	Teaching Hours/ week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BS	22MATM41	Mathematics for MES-IV	Mathematics	3	0	0	3	50	50	100	03
2	PCC	22EG42	Electrical Machines	EEG/EEE	3	0	0	3	50	50	100	03
3	PCC	22EG43	Renewable Energy Technologies	EEG	3	0	0	3	50	50	100	03
4	PCC	22EG44	Fluid Mechanics	EEG	3	0	0	3	50	50	100	03
5	PCC	22EG45	Heat Transfer	EEG	3	0	0	3	50	50	100	03
6	PCC	22EGL46	Electrical Machines Lab-1	EEG/EEE	0	0	2	3	50	50	100	01
7	PCC	22EGL47	Fluid Mechanics Lab	EEG	0	0	2	3	50	50	100	01
8	PCC	22EGL48	Heat Transfer Lab	EEG	0	0	2	3	50	50	100	01
9	PW	22PRJ49	Project-IV	EEG	0	0	2	3	50	50	100	01
10	HSS	22UHV410	Universal Human Values	EEG	3	0	0	3	50	50	100	03
11	AEC	22AEG411	Ability Enhancement Course-IV	EEG	0	0	2	3	50	50	100	01
Total					**18**	**0**	**10**	**33**	**550**	**550**	**1100**	**23**

Note: BS-Basic Science, PCC- Programme Core Course, PW-Project Work, AEC- Ability Enhancement Course, HSS-Humanity and Social Science, NCMC-Non-Credit Mandatory Course.
Project (PRJ): A Batch of 4 students (Same Branch or Different Branches with a Guide, May undertake one project.

Ability Enhancement Course-4

Course code under 22AEG411X	Course Title

22AEG411				Computational Lab								
Courses prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs												
12	**NCMC**	**22MATDIP41**	**Additional Mathematics – II**	**Mathematics**	**2**	**-**	**-**	**-**	**100**	**00**	**100**	**00**

3) Non-Credit Mandatory Courses (NCMC) Additional Mathematics-I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of B. Tech. programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the university examination. In case any student fails to register for the said course/fails to secure the minimum 50% of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the students have to fulfill the requirements during subsequent semester/s to appear for SEE.

4) These courses shall not be mandatory for vertical progression, but completion of the courses shall be mandatory for the award of degree.

Courses prescribed to lateral entry B.Sc. degree holders admitted to III semester of Engineering programs

Lateral entry students from B.Sc. stream, shall clear the non-credit courses Computer Aided Engineering Drawing, Elements of Civil Engineering of First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory
for the award of degree.

AICTE Activity Points to be earned by students admitted to B.Tech. programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines):

Over and above the academic grades, every regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other universities to fifth semester are required to earn 50 activity points from the year of entry to Sharnbasva University. The Activity Points earned shall be reflected on the students eighth semester Grade card.

The activities can be spread over the years, anytime during the semester weekends holidays, as per the liking and convenience of the student from the year of entry to the programme. However, minimum hours requirement should be fulfilled. Activity Points (noncredit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.

In case students fail to earn the prescribed activity points, eighth semester Grade Card shall be issued only after earning the required activity points.

Student shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

MATHEMATICS FOR MECHANICAL ENGINEERING STREAM-IV

Semester: IV

Course	Code	Credits	Total Hours - 45 Hours/Week		Assessment		Exam Duration in Hours
			Lecture	Tutorial	SEE	CIE	
Mathematics for MES - IV	22MATM41	03	03	00	50	50	03

COURSE OBJECTIVES:

The goal of the course Mathematics for Mechanical Engineering Stream-IV (22MATM41) is to

1. Familiarize the importance of numerical methods to solve First order ODE in Mechanical engineering.
2. Introduce most commonly used analytical and numerical methods in the different engineering fields.
3. Understand Joint probability distribution and stochastic processes arising in science and Mechanical engineering.
4. Develop the knowledge of complex variable and discuss the various properties of it.
5. To develop the knowledge of special functions like Bessel and Legendre.
6. Develop the knowledge of sampling theory in day-to-day life and trace different types of curves.

MODULE-1: Numerical Methods-1

Numerical Methods: Numerical solution of ordinary differential equations of first order and first degree, Taylor's series method, modified Euler's-method Runge Kutta method of fourth order. Milne's and Adams- Bashforth predictor and corrector methods (No derivations of formulae). (5 Assignment Problem).

Self-Study: Picard's method

Applications of Numerical Methods: **09 Hours**

MODULE-2 : Numerical Methods-2

Numerical Methods: Numerical solution of second order ordinary differential equations, Runge-Kutta Method and Milne's Method, Numerical solution of P.D.E: Numerical solution of Heat equation, Wave equation, problems. (5 Assignment Problem).

Self-Study: Picard's method, Numerical solution of Laplace's equation

Applications of Numerical Methods: **09 Hours**

MODULE-3: Sampling theory and curve tracing

Sampling theory: Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, Type I and Type II errors, Level of significance, confidence limits for means, one tailed and two tailed tests, student's t-distribution, Chi - square distribution as a test of goodness of fit.

Tracing of curves: Cartesian form - Strophoid, Leminscate, Parametric form - Cycloid, Astroid, Polar form - Cardioid, Leminscate.

Self-Study: Types of samplings, Cartesian equations and their geometrical representation

Applications of Sampling theory and curve tracing: **09 Hours**

MODULE-4: Special Functions

Special Functions: Series solution of Bessel's differential equation leading to J_n (x)-Bessel's function of first kind. Basic properties and orthogonality. Series solution of Legendre's differential equation leading to P_n (x)-Legendre polynomials. Rodrigue's formula, problems

Self-Study : Condtion for Orthogonality, Differential Equations

Applications of Special Functions: **09 Hours**

MODULE-5: Complex variable-2

Complex line Integrals: Cauchy's Integration theorem, Cauchy integral formula, Laurent's Series, types of singularities. Residue, Poles, Cauchy's Residue theorem (without proof) and Problems.

Transformations: Bilinear transformations and problems.

Self-Study : Cauchy Riemann Integral, Singularity Defination.

Applications of Special Functions: **09 Hours**

COURSE OUTCOMES

At the end of this course, student will be able to

CO#	COURSE OUTCOMES
CO1	Solving the first order first degree ordinary differential equations arising in flow problems using single step and multistep numerical methods.
CO2	Use to solve Finite Difference Method and partial differential equations arising in heat , wave and Laplace Equation equations by numerical methods.
CO3	Apply Sampling Distribution to solve Engineering Problems.
CO4	Obtain the series solution of ordinary differential equations and studying special functions.
CO5	Able to Solve complex Integration Problem.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2		1				1			1
CO2	3	2	2		1				1			1
CO3	3	2	2		1				1			1
CO4	3	2	2		1				1			1
CO5	3	2	2		1				1			1

TEXT BOOKS:

1. B.S.Grewal:"Higher Engineering Mathematics", Khanna publishers, 44th Ed.,2021.
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

REFERENCE BOOKS:

1. **V. Ramana:**"Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.,2017
2. **Srimanta Pal & Subodh C. Bhunia**: "Engineering Mathematics" Oxford University Press, 3rdEd., 2016.
3. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications,10th Ed.,2022.

4. **C. Ray Wylie, LouisC. Barrett:**"Advanced Engineering Mathematics" McGraw–Hill Book Co., Newyork, 6thEd., 2017.
5. **Gupta C. B, Sing S. Rand Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education (India)Pvt. Ltd 2015.
6. **H.K. Dass and Er. RajnishVerma:**"Higher Engineering Mathematics" S.Chand Publication, 3rdEd. ,2014
7. **James Stewart: "**Calculus" CengagePublications,7thEd.,2019.
8. **David CLay:**"Linear Algebra and its Applications", Pearson Publishers,4th Ed.,2018
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6thEd., 2017.

SCHEME OF EXAMINATION:

Two questions to be set from each module. Students have to answer five full questions choosing at least one full question from each module.

ELECTRICAL MECHINES

Semester: IV

Course	Code	Credits	Total Hours - 45 Hours/Week		Assessment		Exam Duration in Hours
			Lecture	Tutorial	SEE	CIE	
Electrical Machines	22EG42	03	03	00	50	50	03

COURSE OBJECTIVES:

This course will enable the students:

1) To understand the concepts of transformers and their analysis and suggest a suitable three phase transformer connections for a particular application.
2) To explain the required conditions for the parallel operation of transformers.
3) To study different tests to be conducted for the assessment of the performance characteristics of DC motors.
4) To understand the different tests on DC motor.
5) To Explain the construction and operation of Synchronous generators and to evaluate their performance.

MODULE-1

Single phase Transformers: Operation of practical transformer under no-load and on-load conditions with Phasor diagrams. Open circuit and short circuit tests, calculation of equivalent circuit parameters and predetermination of efficiency-commercial and all-day efficiency. Voltage regulation and its significance.

Three-phase Transformers: Introduction, Constructional features of three-phase transformers. Choice between single unit three-phase transformer and a bank of three single-phase transformers. Transformer connection for three phase operation– star/star, delta/delta, star/delta, zigzag/star and V/V, comparative features. Phase conversion-Scott connection for three-phase to two-phase conversion. Labelling of three-phase transformer terminals, vector groups. 09 Hours

MODULE-2

Transformers (Continuation): Polarity test, Sumpner's test, separation of hysteresis and eddy current losses.

Parallel Operation of Transformers: Necessity of Parallel operation, conditions for parallel operation – Single phase and three phase transformers. Load sharing in case of similar and dissimilar transformers.

D.C. Machines: Working principle of D.C. Machine as a generator and a motor. Types and constructional features. Types of armature windings, Emf equation of generator, relation between induced emf and terminal voltage with an enumeration of brush contact drop and drop due to armature reaction. Illustrative examples, neglecting armature reaction. 09 Hours

MODULE-3

D.C. Machines (Continuation): Operation of D.C. motor, Back emf and its significance, torque equation. Types of D.C. motors, characteristics and applications. Necessity of a starter for D.C. motor. Illustrative examples on back emf and torque.

Testing of dc motors: Direct & indirect methods of testing of DC motors-Brake test, Swinburne's test, Retardation test, Hopkinson's test, Field's test, merits and demerits of tests. 09 Hours

MODULE-4

Three Phase Synchronous Generators: Principle of operation, Types and constructional features, Advantages of rotating field type alternator, Synchronous speed, Frequency of generated voltage, Emf equation. Concept of winding factor (excluding the derivation of distribution and pitch factors). Illustrative examples on emf equation. 09 Hours

MODULE-5

Three Phase Induction Motors: Principle of operation, Concept and production of rotating magnetic field, Synchronous speed, rotor speed, Slip, Frequency of the rotor induced emf, Types and Constructional features. Slip and its significance. Applications of squirrel - cage and slip – ring motors. Illustrative examples on slip calculations..

Starting and speed Control of Three-phase Induction Motors: Need for starter. Direct on line, Star-Delta and autotransformer starting. Rotor resistance starting. Speed control by voltage, frequency, and rotor resistance methods. 09 Hours

COURSE OUTCOMES

At the end of this course, student will be able to

CO#	COURSE OUTCOMES
CO1	Explain the construction, operation and performance of single phase and three phase transformers.
CO2	Explain the use of auto transformer, tap changing and tertiary winding transformer and need of operating transformers in parallel and explain the working principle of D.C. Machine as a generator.
CO3	Analyze and assess the performance characteristics of DC motors by conducting suitable tests and control the speed by suitable method.
CO4	Explain the construction and operation of Synchronous generators.
CO5	Explain the constructional features of Three Phase induction Motors and assess their performance. And control the speed of three-phase Induction Motor by a suitable method.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	2								2
CO2	2	1	1									2
CO3	2	1	1									1
CO4	2	1	2		2	2	2					2
CO5	2	1	2	2	2	2	2					3

TEXT BOOKS:

1. Electrical Technology AC & DC Machines, B.L. Thereja and A. K. Thereja S. CHAND Publications Reprint 2014.
2. Electric Machines D. P. Kothari, et al McGraw Hill 4th Edition, 2011
3. Performance and Design of A.C. Machines M. G. Say CBS Publishers 3rd Edition, 2002
4. Electrical machinery, P.S Bhimbra, Khanna Publishers

REFERENCES:

1) Principles of Electric Machines P.C.Sen Wiley 2nd Edition, 2013
2) Electric Machines MulukuntlaS.Sarma,at el Cengage 1st Edition, 2009
3) Performance & Design of Alternating Current machines, M. G. Say, CBS publishers,3rd Edition,2002.
4) The Performance & Design of DC machines A. E Clayton &N.N.Hancock CBS Publication,3rd Edition,2004.
5) Electrical Machines,Ashfaq Hussain, Dhanpat Rai Publications.

SCHEME OF EXAMINATION:

Two questions to be set from each module. Students have to answer five full questions choosing at least one full question from each module.

RENEWABLE ENERGY TECHNOLOGIES

Semester: IV

Course	Code	Credits	Total Hours - 45 Hours/Week		Assessment		Exam Duration in Hours
			Lecture	Tutorial	SEE	CIE	
Renewable Energy Technologies	**22EG43**	**03**	**03**	**00**	**50**	**50**	**03**

COURSE OBJECTIVES:

1) To discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.
2) To explain solar geometry and solar thermal applications.
3) To discuss benefits of hydrogen energy, production of hydrogen energy.
4) To discuss wind turbines, wind resources, site selection for wind turbine.
5) To discuss geothermal systems, and geothermal based electric power generation
6) To discuss waste recovery management systems.
7) To discuss biogas, its composition, production, benefits.
8) To discuss tidal energy and wave energy resources.

MODULE-1

Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.

Energy from Sun: Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications. 09 Hours

MODULE-2

Solar Thermal Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine.

Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar Pond. 09 Hours

MODULE-3

Hydrogen Energy: Benefits of Hydrogen Energy, Hydrogen Production Technologies, Hydrogen Energy Storage, Use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems Associated with Hydrogen Energy. Wind Energy: Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection.

Geothermal Energy: Geothermal Systems, Classifications, Geothermal Resource Utilization, Resource Exploration, Geothermal Based Electric Power Generation, Associated Problems, environmental Effects. 09 Hours

MODULE-4

Biogas Energy: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefits of Biogas, Factors Affecting the Selection of a Particular Model of a Biogas Plant, Biogas Plant Feeds and their Characteristics.

Tidal Energy: Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Leading Country in Tidal Power Plant Installation, Energy Availability in Tides, Tidal Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy. 09 Hours

MODULE-5

Ocean Thermal Energy: Introduction, Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants, Basic Rankine Cycle and its Working, Closed Cycle, Open Cycle and Hybrid Cycle, Carnot Cycle, Application of OTEC in Addition to Produce Electricity, Advantages, Disadvantages and Benefits of OTEC.

Wave Energy: Introduction, Motion in the sea Waves, Power Associated with Sea Waves, Wave Energy Availability, Devices for Harnessing Wave Energy, Advantages and Disadvantages of Wave Power. 09 Hours

COURSE OUTCOMES

At the end of this course, student should be able to

CO#	COURSE OUTCOMES
CO1	Discuss scenario of renewable energy sources and solar geometry.
CO2	Analyse the solar thermal energy conversion.
CO3	Explain generation of energy from hydrogen, wind and geothermal system.
CO4	Discuss production of energy from biogas and tidal energy resources.
CO5	Summarize ocean thermal energy and wave energy.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1		2	1	2	1				1
CO2	3	2	1		2	1	2	1				1
CO3	3	2	1		2	1	2	1				1
CO4	3	2	1		2	1	2	1				1
CO5	3	2	1		2	1	2	1				1

TEXT BOOKS:

1. Nonconventional Energy Resources by G D Rai, Khanna Publication.

REFERENCES:

1. Nonconventional Energy Resources B.H. Khan McGraw Hill 3rd Edition
2. Renewable Energy; Power for a sustainable Future Godfrey Boyle Oxford 3rd Edition, 2012

SCHEME OF EXAMINATION:

Two questions to be set from each module. Students have to answer five full questions choosing at least one full question from each module.

FLUID MECHANICS

Semester: IV

Course	Code	Credits	Total Hours - 45 Hours/Week		Assessment		Exam Duration in Hours
			Lecture	Tutorial	SEE	CIE	
Fluid Mechanics	**22EG44**	**03**	**03**	**00**	**50**	**50**	**03**

COURSE OBJECTIVES:

1. To understand the basic principles and fundamental concepts of fluid mechanics.
2. To make the students to understand the concept and apply the various laws solving the fluid engineering problems.
3. To make the students familiar with measurements and visualisation of fluid flow types, kinematics, dynamics and its analysis.
4. To understand the concept flow of liquids through pipes and different sections and the dimensional quantities.

MODULE-1

Basics concepts and definitions: Introduction, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, compressibility and bulk modulus**.**

Fluid pressure at a point, Pascal's Law, Pressure Variation in Fluid at rest, Types of fluids, Absolute, Gauge, Atmosphere and Vacuum Pressure, simple numerical. 09 Hours

MODULE-2

Pressure measurement: Simple Manometers (Piezometers, U-tube Manometers and Single Column Manometers), differential manometers (U-tube and Inverted U-Tube differential manometers)

Fluid Statics: Introduction, Hydrostatic forces on submerged horizontal plane, vertical plane and inclined plane to determine total pressure and centre of pressure in static fluid, Definition of Buoyance, Centre of Buoyance, Meta Centre, Meta centric Height and simple numerical. 09 Hours

MODULE-3

Fluid Kinematics: Introduction, Method of describing fluid motion, Types of flows - steady, unsteady, uniform, non-uniform, laminar, turbulent, one, two and three dimensional, compressible, incompressible, rotational, irrational flow, Continuity Equation, Continuity Equation in Three Dimensions.

Velocity and Acceleration, velocity components, convective and local acceleration, velocity potential and stream function and types of motion. 09 Hours

MODULE-4

Fluid Dynamics; Introduction, Forces acting on fluid in motion. Euler's equation of motion along a streamline, Integration of Euler's equation to obtain Bernoulli's equation, Assumptions and limitations of Bernoulli's equation, simple numerical

Fluid Flow Measurements: Introduction to Navier-Stokes equation, Application of Bernoulli's theorem such as venturi-meter, orifice meter and pitot tube, Simple numerical. 09 Hours

MODULE-5

Notches and weirs: Introduction, classification, rectangular notch, triangular Notch, Trapezoidal notch (Simple Numerical).

Dimensional Analysis: Introduction, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham Pi-theorem, similitudes- Types of similarities, Forces acting in moving fluid, dimensionless numbers, Simple Numerical. 09 Hours

COURSE OUTCOMES

At the end of this course, student should be able to

CO#	COURSE OUTCOMES
CO1	Analyse a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
CO2	Study the concept of measurements of fluid, and study of fluid at static or rest.
CO3	Visualise different types of fluid flow, and compare them based on kinematic flow descriptions.
CO4	Know the mass and momentum is conserved based on Bernoulli's & Newton's laws and its applications.
CO5	Know concept of dimensional quantities, study of notches, wire and its application

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		1	1	1						1
CO2	3	2		1	1	1						1
CO3	2	2		1	1	1						1
CO4	3	2		1	1	1						1
CO5	3	2		1	1	1						1

TEXTBOOKS:

1. A Text Book of Fluid Mechanis And Hydraulic Machines Dr R.K Bansal Laxmi Publishers
2. Fluid Mechanics F M White McGraw Hill Publications Eighth edition. 2016
3. Fluid Mechanics (SI Units) Yunus A. Cengel John M.Cimbala TataMcGraw Hill 3rd Ed.,2014.

REFERENCE:

1. Fluid Mechanics, Oijush.K.Kundu, IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.
2. Fluid Mechanics and hydraulics, Dr.Jagadishlal: Metropolitan Book Co-Ltd., 1997.Fluid Mechanics, John F. Douglas, Janul and M.Gasiosek and john A.Swaffield, Pearson Education Asia, 5th ed., 2006.
3. Fluid Mechanics and Fluid Power Engineering, Kumar.D.S, Kataria and Sons, 2004
4. Fluid Mechanics -. Merle C. Potter, Elaine P.Scott. Cengage learning.

SCHEME OF EXAMINATION:

Two questions to be set from each module. Students have to answer five full questions choosing at least one full question from each module.

HEAT TRANSFER

Semester: IV

Course	Code	Credits	Total Hours - 45		Assessment		Exam Duration in Hours
			Hours/Week				
			Lecture	Tutorial	SEE	CIE	
Heat Transfer	22EG45	03	03	00	50	50	03

COURSE OBJECTIVES:

Upon successful completion of the course the students will be familiar with

1. To explain the basic modes of heat transfer, applications, fundamental rule and one-dimensional steady state heat transfer with boundary condition.
2. To understand the concept of fins and its application for various engineering field.
3. Learn how to formulate and solve 1-D steady heat conduction problems
4. To comprehend the heat transfer due to free and forced convective heat transfer.
5. Understand the principles of radiation heat transfer related engineering problems.
6. Study the basic principles of heat exchanger analysis, LMTD and thermal design.

MODULE-1

Introductory Concepts and Definitions: Modes of heat transfer: Basic laws of governing conduction, convection and radiation heat transfer, Thermal conductivity, convective heat transfer coefficient, radiation heat transfer and combined heat transfer mechanism, Types of boundary condition, general heat conduction equation: derivation of the equation in cartesian and polar co-ordinate system, Simple numerical.

One Dimensional Steady State Heat Conduction: steady state one dimensional heat conduction problems without heat generation for slab, composite wall, and cylinder wall in cartesian system with various possible boundary condition. 09 Hours

MODULE-2

Critical Thickness of insulation: introduction, Critical Thickness of insulation for Cylinder surface and spherical surface, simple numerical.

Fins: Fins, Necessity of fins, types of fins, application, steady state heat conduction in fins of uniform cross section Rectangular and circular fins, case1: Infinitely long fin, case 2: fin with insulated end, efficiency and effectiveness of fin. 09 Hours

MODULE-3

Forced convection: introduction, dimensional analysis of forced convection, significance, correlation for forced convection, simple numerical

Natural convection: introduction, dimensional analysis of free convection, significance, correlation for free convection, simple numerical. 09 Hours

MODULE-4

Radiation: introduction, characteristics, absorptivity, reflectivity and transmissivity of black, Gray and white body, Stefan Boltzman law, total emissive power, Planck's law, Rayleigh jeans law, Wein's displacement law, Kirchhoff's law, concept of gray body, emissivity.

Heat exchange between black bodies, heat exchange between gray bodies, Radiation shield, electrical network for radiation heat exchanger, simple numerical. 09 Hours

MODULE-5

Heat Exchanger: Introduction, Classification, over all heat transfer coefficient, fouling, analysis of heat exchanger: LMTD Parallel flow and counter flow.

Capacity rates, Analysis of heat exchanger by NTU-Effective method: parallel and counter flow heat exchanger, heat pipe and simple numerical. 09 Hours

COURSE OUTCOMES

At the end of this course, student should be able to

CO#	COURSE OUTCOMES
CO1	Know the modes of heat transfer and apply the basic laws to formulate engineering systems.
CO2	Apply the basic laws of heat transfer to extended surface, fins and problems
CO3	Analyze heat transfer due to free and forced convective heat transfer.
CO4	Analyze heat conduction through numerical methods and apply the fundamental principle to solve radiation heat transfer problems.
CO5	Design and performance analysis of heat exchangers and their practical applications.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2			2	1		1				1
CO2	3	2			2	1		1				1
CO3	3	2			2	1		1				1
CO4	3	2			2	1		1				1
CO5	3	2			2	1		1				1

TEXT BOOKS:

1. Principals of heat transfer,FrankKreith, Raj M. Manglik, Mark S. Bohn, Seventh Edition, Cengage learning, 2011.
2. Yunus A. Cengel - Heat transfer, a practical approach, Fifth edition,Tata Mc Graw Hill.
3. J P Holman, Souvik Bhattacharyya, 10th Edition, McGraw Hill Education Private Ltd.,

REFERENCE BOOKS

1. Heat and mass transfer, Kurt C, Rolle, second edition, Cengage learning.
2. Heat Transfer, M. NecatiOzisik, A Basic Approach, McGraw Hill, New York, 2005.
3. Fundamentals of Heat and Mass Transfer, Incropera, F. P. and De Witt, D. P., 5th Edition, John Wiley and Sons, New York, 2006.
4. Heat Transfer, Holman, J. P., 9th Edition, Tata McGraw Hill, New York, 2008.

SCHEME OF EXAMINATION:

Two questions to be set from each module. Students have to answer five full questions choosing at least one full question from each module.

ELECTRICAL MACHINES LAB-1

Semester: IV

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Practical	SEE	CIE	
Electrical Machine Lab-1	**22EGL46**	**01**	**00**	**03**	**50**	**50**	**03**

COURSE OBJECTIVES:

This course will enable the students:

1. Conducting different tests on transformers and Induction machines and evaluating their Performance.
2. Verify the parallel operation of two single phase transformers.
3. Study the connection of single-phase transformers for three phase operation and phase conversion.
4. To conduct load test on single phase and three phase induction motors.
5. To conduct test on induction motor to determine the performance characteristics.

LIST OF EXPERIMENTS:

PART-A

1. (a)Predetermination of efficiency and regulation by Open Circuit and Short circuit tests on single - phase transformer. (b)Calculation of parameters of equivalent circuit from the readings of the tests and determination of efficiency and regulation from the equivalent circuit to correlate results obtained earlier.
2. Sumner's test on similar transformers and determination of combined and individual transformer efficiency.
3. Parallel operation of two dissimilar (different kVA) single-phase transformers and determination of load sharing and analytical verification-given the Open Circuit and Short circuit tests details.
4. Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load.
5. Scott connection with balanced and unbalanced resistive loads.

PART-B

1. Load test on 3-phase induction motor- and plot of Torque versus speed, output hp versus efficiency, power factor and slip.
2. (a)Determination of parameters of the equivalent circuit of a 3-phase Induction Motor by conducting NO load and Blocked rotor tests. (b)Determination of performance parameters of the induction motor from the equivalent circuit to correlate the results obtained from the load test or circle diagram.
3. Speed control of 3-phase induction motor by varying rotor resistance.
4. Load test on- induction generator.
5. Load test on single- phase induction motor.

COURSE OUTCOMES:

At the end of this course, student will be able to

CO#	COURSE OUTCOMES
CO1	Evaluate the performance of transformers from the test data obtained.
CO2	Connect and operate two single phase transformers of different KVA rating in parallel.
CO3	Connect single phase transformers for three phase operation and phase conversion.
CO4	Perform load test on single phase and three phase induction motors to assess the performance.
CO5	Conduct test on induction motor to pre-determine the performance characteristics

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1		2		1		2			2
CO2	2	1	2	1	2		2		2			2
CO3	3	1	2	1	2				2			2
CO4	2	2	1	1		2			2			2
CO5	2	1	1	1		2			2			2

Conduct of Practical Examination:

1) All laboratory experiments are to be included for practical examination.
2) Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3) Students can pick one experiment from the questions lot prepared by the examiners.
4) Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero

Scheme of Examination:

ONE question from par –A: 15 Marks
ONE question from part –B: 25Marks
Viva -Voice : 10 Marks
Total : 50 Marks

FLUID MECHANICS LAB

Semester: IV

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Practical	SEE	CIE	
Fluid Mechanics Lab	**22EGL47**	**01**	**00**	**03**	**50**	**50**	**03**

COURSE OBJECTIVES:

Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.

LIST OF EXPERIMENTS:

PART-A

1) Study of taps, valves, pipe fittings, gauges, pitot tubes, water meters and current meters.
2) Calibration of Pressure gauges
3) Determination of metacentric height and radius of gyration of floating bodies.
4) Verification of Bernoulli's theorem
5) Reynolds experiment

PART-B

6) Determination of the Coefficient of discharge of given Venturi meter
7) Determination of the Coefficient of discharge of given Orifice meter.
8) Determination of the Coefficient of discharge of given V-Notch 600, and 900.
9) Determination of the Coefficient of discharge of given V-Notch rectangular notch
10) Determination of friction factor for a given set of pipes.
    a) Major loss.
    b) Minor loss.

COURES OUTCOMES:

At the end of the course the student will be able to:

CO#	COURSE OUTCOMES
CO1	Study the types of valves, taps, pipe fitting and gauges.
CO2	Know the measurement of pressure gauge and to measure metacentric height of floating body.
CO3	Apply the concept of Bernoulli's and Reynolds number.
CO4	Analyse the different flow measurement equipment's and their procedures.
CO5	Able to develop the skill of experimentation techniques for the study of flow phenomena in channels/pipes.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2						1	1			1
CO2	3	2						1	1			1
CO3	3	2						1	1			1
CO4	3	2						1	1			1
CO5	3	2						1	1			1

Conduct of Practical Examination:

1) All laboratory experiments are to be included for practical examination.
2) Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3) Students can pick one experiment from the questions lot prepared by the examiners.
4) Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Scheme of Examination:

ONE question from par –A: 20 Marks
ONE question from part –B: 20Marks
Viva -Voice : 10 Marks
Total : 50 Marks

HEAT TRANSFER LAB

Semester: IV

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Practical	SEE	CIE	
Heat Transfer Lab	**22EGL48**	**01**	**00**	**03**	**50**	**50**	**03**

COURSE OBJECTIVES:

Upon successful completion of this laboratory, the students should be able to have hands on experience in

1. The primary objective of this course is to provide the fundamental knowledge necessary to understand the behavior of thermal systems.
2. This course provides a detailed experimental analysis, including the application and heat transfer through solids, fluids, and vacuum.
3. Convection, conduction, and radiation heat transfer in one and two dimensional steady and unsteady systems are examined.

PART-A

1. Determination of Thermal Conductivity of a Metal Rod
2. Determination of Overall Heat Transfer Coefficient of a Composite wall.
3. Determination of Effectiveness on a Metallic fin.
4. Determination of Heat Transfer Coefficient in free Convection
5. Determination of Heat Transfer Coefficient in a Forced Convention
6. Determination of Emissivity of a Surface.

PART-B

1. Determination of Stefan Boltzmann Constant.
2. Determination of LMDT and Effectiveness in Parallel Flow Heat Exchangers.
3. Determination of LMDT and Effectiveness in Counter Flow Heat Exchangers.
4. Performance Test on a Vapour Compression Refrigeration.
5. Performance Test on a Vapour Compression Air – Conditioner.

COURSE OUTCOMES

At the end of this course, student should be able to:

CO#	COURSE OUTCOMES
CO1	Determine the thermal conductivity of a metal rod and overall heat transfer coefficient of composite slabs.
CO2	Determine convective heat transfer coefficient for free and forced convection and correlate with theoretical values.
CO3	Comprehend the surface emissivity of a given test plate.
CO4	Determine surface emissivity of Stefan Boltzmann constant.
CO5	Estimate performance of a refrigerator and effectiveness of a fin and Double pipe heat exchange.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1					1	1				1
CO2	1	1					1	1				1
CO3	1	1					1	1				1
CO4	1	1					1	1				1
CO5	1	1					1	1				1
CO6	1	1					1	1				1

Scheme of Examination:

ONE question from part –A: 15 Marks
ONE question from part –B: 25Marks
Viva -Voice: : 10 Marks
Total: : 50 Marks

PROJECT-IV

Semester: IV

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Project	SEE	CIE	
Project-IV	**22PRJ49**	**01**	**00**	**02**	**50**	**50**	**03**

OBJECTIVES:

To Introduce fundamental concepts and analysis techniques in engineering to students across all disciplines.

Mini-Project Work:

Based on the ability/abilities of the students and recommendations of the mentor, a single discipline or a multidisciplinary Mini-Project can be assigned to an individual student or to a group having not more than 4 students.

COURSE OUTCOMES

At the end of this course, student should be able to:

CO#	COURSE OUTCOMES
CO1	Comprehend how to identify issues related to environment, society and industry.
CO2	Able to prepare the model and report on society, environment and industry related projects.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2		1	2	2	1	2	1	1	1
CO2	2	2	2		1	2	2	1	2	1	1	1

Scheme of Examination:

Write up : 15 Marks
Demonstration : 25 Marks
Viva -Voice: : 10 Marks
Total: : 50 Marks

UNIVERSAL HUMAN VALUES

Semester: IV

Course	Code	Credits	Total Hours - 40 Hours /Week		Assessment		Exam Duration in hrs
			Lecture	Tutorial	SEE	CIE	
Universal Human Values	**22UHV410**	**03**	**03**	**00**	**50**	**50**	**03**

COURSE OBJECTIVES: Upon successful completion of the course the students will be familiar with

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

MODULE 1:

Introduction to Value Education

Introduction to Value Education: Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 Sharing about Oneself

Lecture 3: Self-exploration as the Process for Value Education

Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial 3: Practice Session PS3 Exploring Natural Acceptance. 09 Hours

MODULE 2:

Module 2 – Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7: Understanding Human being as the Co-existence of the Self and the Body

Lecture 8: Distinguishing between the Needs of the Self and the Body

Tutorial 4: Practice Session PS4 Exploring the difference of Needs of Self and Body

Lecture 9: The Body as an Instrument of the Self

Lecture 10: Understanding Harmony in the Self

Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the Self

Lecture 11: Harmony of the Self with the Body

Lecture 12: Programme to ensure self-regulation and Health

Tutorial 6: Practice Session PS6 Exploring Harmony of Self with the Body 09 Hours

MODULE 3:

Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction

Lecture 14: 'Trust' – the Foundational Value in Relationship

Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust

Lecture 15: 'Respect' – as the Right Evaluation

Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect

Lecture 16: Other Feelings, Justice in Human-to-Human Relationship

Lecture 17: Understanding Harmony in the Society

Lecture 18: Vision for the Universal Human Order 09 Hours

MODULE 4:

Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)

Lecture 19: Understanding Harmony in the Nature

Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature

Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature

Lecture 21: Realizing Existence as Co-existence at All Levels

Lecture 22: The Holistic Perception of Harmony in Existence

Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence 09 Hours

MODULE 5:

Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)

Lecture 23: Natural Acceptance of Human Values

Lecture 24: Definitiveness of (Ethical) Human Conduct

Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order

Lecture 26: Competence in Professional Ethics

Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education

Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies

Lecture 28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order 09 Hours

OUTCOMES: After studying this course, students will be able to:

CO#	COURSE OUTCOMES
CO1	Present sustainable solutions to the problems in society and nature.
CO2	See that these solutions are practicable and draw roadmaps to achieve them.
CO3	Grasp the right utilization of their knowledge in their streams of Technology/Engineering/Management/any other area of study to ensure mutual fulfilment. E.g. mutually enriching production system with rest of nature.
CO4	Sincerely evaluate the course and share with their friends. They are also able to suggest

	measures to make the course more effective and relevant.
CO5	Make use of their understanding in the course for the happy and prosperous family and society.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	3	-	-	-	-	2
CO2	-	-	-	-	-	3	2	-	-	-	-	2
CO3	-	-	-	-	-	-	3	-	-	-	-	2
CO4	-	-	-	-	-	-	-	-	3	-	-	2
CO5	-	-	-	-	-	3	-	-	-	-	-	2

TEST BOOKS:

1. The Textbook - A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. The Teacher's Manual- Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53

REFERENCE BOOKS:

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

COMPUTATIONAL LAB

Semester: IV

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Practical	SEE	CIE	
Computational Lab	**22AEG411**	**01**	**00**	**01**	**50**	**50**	**03**

OBJECTIVES:

1. Understand the basics of Solid Edge 2D and its applications in engineering.
2. Acquire proficiency in creating and editing 2D drawings using Solid Edge.
3. Develop skills in dimensioning and annotating drawings for clear communication.
4. Explore methods for creating accurate geometric constraints and relationships.
5. Familiarize yourself with advanced tools and features for enhancing 2D drawings.
6. Apply acquired knowledge to solve real-world engineering problems using Solid Edge.

COURSE DETAILS:

Introduction to Solid Edge 2D, Introduction to Solid Edge 2D interface and workspace Understanding files management and project organization, Sketching and Drawing Tools, Creating and modifying 2D sketches, Exploring different sketching techniques and tools, Using geometric constraints to control sketch behaviour, Dimensioning and Annotations, Adding accurate dimensions to sketches and drawings, Understanding different dimensioning systems (metric, imperial), Annotating drawings with text, symbols, and callouts, Creating and managing parts in Solid Edge and simple line diagrams (i.e Simple Rankine Cycle, Open cycle OTEC, Closed cycle OTEC , steam power plant, Diesel power plant, Energy conversion wind power plant, Reheat cycle ,Regenerative cycle, Vapour dominated or dry steam system and Indian digester.

COURSE OUTCOMES

At the end of this course, student should be able to:

	COURSE OUTCOMES
CO1	Comprehend different tools, dimensions and constraints to sketches for accurate design representation.
CO2	Understand layout of vapour power cycle, OTEC, Diesel cycle, steam power plant and vapour dominated.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1		1					2		2
CO2	3	2	1		1					2		2

Scheme of Examination:

Write-up : 25 Marks
Demonstration : 25 Marks
Total : 50 Marks

ADDITIONAL MATHEMATICS-II

Semester: IV

Course	Code	Credits	Total Hours		Assessment		Exam Duration in hrs
			Hours /Week				
			Lecture	Practical	SEE	CIE	
Additional Mathematics-II	**22MATDIP41**	**00**	**02**	**00**		**50**	**03**

COURSE OBJECTIVES:

1. Solve first order differential equations.
2. Solve second and higher order differential equations.
3. Understand and solve the partial differential equation.
4. To acquire the knowledge of elementary probability theory.
5. Know the basic concepts of evaluation of double and triple integrals.

MODULE 1: DIFFERENTIAL EQUATIONS - 1

Differential Equation-1: Solution of first order and first-degree differential equations: Variable separable, Homogeneous, Exact and Reducible to exact differential equation, Linear differential equation. Applications of first order first degree differential equations: Newton's law of cooling.

05 Hours

MODULE 2: DIFFERENTIAL EQUATIONS - 2

Differential Equations-2: Solution of second & higher order Ordinary linear differential equation with constant co-efficients. Method of variation of parameters. Solution of homogeneous LDE by Power series solution Method. 05 Hours

MODULE 3: PARTIAL DIFFERENTIAL EQUATIONS (PDE's)

Partial Differential Equations (PDE's): Formation of PDE by eliminating arbitrary constant & functions, Solution of Non-homogeneous PDE by direct integration, solution of homogeneous PDE with respect to one independent variable only. Derivation of one-dimensional wave equation and heat equation and Various possible solution of wave & heat equations by methods of separation of variables. 05 Hours

MODULE 4: IMPROPER INTEGRALS

Improper Integrals: Beta and gamma functions and its properties and examples. Evaluation of double integral over a specific region, changing the order of integration, changing into polar form.

05 Hours

MODULE 5: PROBABILITY

Probability: Introduction, Sample space and Events. Axioms of Probability, Addition & Multiplication theorems. Conditional probability- illustrative examples. Baye's theorem-examples. 05 Hours

COURSE OUTCOMES

At the end of this course, student should be able to

CO#	COURSE OUTCOMES
CO1	Apply the knowledge of differential equation of first order to solve examples based on Newton's law of cooling.

CO2	Solve second and higher order differential equations occurring in of electrical circuits, damped/un-damped vibrations. Explain the applications of Power series and obtain series solution of ordinary differential equations.
CO3	Construct a variety of partial differential equations and solution by exact Methods / method of separation of variables.
CO4	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.
CO5	Apply the knowledge of Probability to solve the simple real life problems

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1		1				1			1
CO2	3	2	1		1				1			1
CO3	3	2	1		1				1			1
CO4	3	2	1		1				1			1
CO5	3	2	1		1				1			1

TEACHING LEARNING PROCESS:

CIE + Assignments: 15+35=50 Marks

There will be a 2 CIE's, the best one among 2 CIE's will be considered and there will be 35 marks for Assignments

TEXT BOOKS:

1. B.S. Grewal : Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
2. E. Kreyszig : Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.

REFERENCE BOOKS:

1. C.Ray Wylie, Louis C.Barrett : "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Book Co., New York, 1995.
2. James Stewart : "Calculus –Early Transcendentals", Cengage Learning India Private Ltd., 2017.
3. B.V.Ramana : "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. Srimanta Pal & Subobh C Bhunia:"Engineering Mathematics", Oxford University Press,3rd Reprint,2016.
5. Gupta C.B., Singh S.R. and Mukesh Kumar: "Engineering Mathematics for Semester I & II", Mc-Graw Hill Education (India) Pvt.Ltd., 2015.