SCHEME OF INSTRUCTION & EXAMINATION
B.E. IV - Semester
(MECHANICAL ENGINEERING)

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1.	BS401MT	Engineering Mathematics-IV	3	1	-	4	30	70	3	3
2.	ES422EE	Electrical Circuits & Machines	3	-	-	3	30	70	3	3
3.	ES934EC	Basic Electronics	3	-	-	3	30	70	3	3
4.	PC401ME	Applied Thermodynamics	4	-	-	4	30	70	3	4
5.	PC402ME	Kinematics of Machines	4	1	-	5	30	70	3	4
6.	PC403ME	Design of Machine Elements	4	-	-	4	30	70	3	4
Practical/Laboratory Courses										
7.	ES461EE	Electrical Circuits & Machines Lab.	-	-	2	2	25	50	3	1
8.	ES955EC	Basic Electronics Lab.	-	-	2	2	25	50	3	1
9.	PC451ME	Applied Thermodynamics Lab.	-	-	2	2	25	50	3	1
Total			**21**	**2**	**6**	**29**	**255**	**570**		**24**

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course
PC: Professional Course HS: Humanities and Sciences
L: Lectures T: Tutorials Pr : Practicals Drg: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

Course Code	Course Title						Core / Elective
BS 401 MT	**ENGINEERING MATHEMATICS-IV**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	1	-	-	**30**	**70**	**3**

Course Objectives

- To provide the knowledge of some probability distributions, tests of significance.
- To understand curve fitting, correlation and regression.
- To introduce a few numerical methods to solve certain types of problems.

Course Outcomes

- To solve problems in probability and statistics, perform a regression analysis and to compute and interpret the coefficient of correlation.
- To find numerical solution of algebraic, transcendental equations and ordinary differential equations.

UNIT-I

Statistics: Introduction to Probability, Baye's theorem, random variables, Density functions, Mathematical expectation, Expected values, Moments and Moment generating functions, Characteristic functions.

UNIT-II

Distributions: Poisson, Normal, Gamma and Chi-Square distributions, Tests of significance, Chi-Square, F and t-tests.

UNIT-III

Curve fitting by method of least squares: Fitting of curves by the method of least squares (straight line, parabola, exponential curves), Correlation and Regression, Lines of regression.

UNIT-IV

Numerical methods: Solution of Algebraic and Transcendental equations: Bisection method, Regula-false method, Newton Raphson method, Iteration method. Solution of linear system of equations: Gauss elimination method, Gauss-Seidel iteration method, Interpolation: Newton's Forward and Backward difference interpolations, Interpolation with unequally spaced intervals Lagrange's interpolation, Newton's divided difference.

UNIT-V

Numerical differentiation and integration: Trapezoidal rule, Simon's 1/3rd rule, Simpson's $3/8^{th}$ rule, Numerical differentiation. Numerical solutions of ordinary differential equations: Taylor's series method, Euler method, Modified Euler's method, Runge-Kutta method of 4^{th} order.

Suggested Reading*:*

1. Dr.B.S.Grewal **Numerical Methods in Engineering and Science with Programs in C and C+ +**
2. S.C.Gupta, V.K.Kapoor, **Fundamentals of Mathematical Statistics**, S.Chand & Sons.
3. R.K.Jain & S.R.K. Iyengar, **Advanced Engineering Mathematics**, Narosa Publication, 4th Edition, 2014.
4. Erwin Kreyszig, **Advanced Engineering Mathematics**, 9th Edition, 2012.

Course Code	Course Title						Core / Elective
ES 422 EE	**ELECTRICAL CIRCUITS AND MACHINES**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To acquire knowledge in electrical circuits.
- To be able to understand the basic principle operation and performance of electrical machines.

Course Outcomes

- Know the basics of Electrical Engineering with good knowledge on underlying principles of operation.
- Relate these basics with daily experiences.

UNIT I

DC Circuits: Ohm's law, Network elements, Kichhoff's laws, Power in DC circuits, Series & parallel resistances, Thevenin's and Norton's theorems. AC Circuits: Sinusoidal sources, Phasor representation of sinusoidal quantities, Average and RMS values, Form factor, Analysis of RLC circuits to sinusoidal inputs, Power factor, Active & reactive powers, energy stored in inductance and capacitance, Mutual inductance.

UNIT II

Three-Phase Circuits: Production of 3-phase voltages, balanced star and delta connections, Measurement of power by Two-wattmeter method. Single Phase Transformers: Principle of operation, Transformer on No-load and Load, Equivalent circuit, Efficiency & regulation, O.C and S.C tests, Principle of autotransformer.

UNIT III

DC Machines: Construction and working principle of generator and motor, EMF in generator, Types of excitation, Characteristics of series and shunt generators, Applications, Torque in a DC motor, Characteristics of shunt and series motors, Speed control of dc shunt motors, Losses & efficiency, Three point starter.

UNIT IV

Three-Phase Induction Motors: Production of rotating magnetic field, Construction and principle of Induction motors, Torque-slip characteristics, Star delta and Autotransformer starters, Speed control by Stator voltage and Rotor resistance methods.

UNIT V

Single-Phase Motors: Capacitor start and Capacitor run motor, Universal motors. Three - Phase alternators: Construction, emf equation, Regulation by synchronous impedance method.

Suggested Reading:

1. Naidu M.S. & Kamakshiah S, "**Introduction to Electrical Engineering**", Tata McGraw Hill, 1995
2. Mehta V.K., "**Principles of Electrical Engineering and Electronics**", S.Chand & Co.,1995
3. A.Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, "**Basic Electrical Engineering**"
4. Tata McGraw Hill Education PVT LTD, 2009

Course Code	Course Title						Core / Elective
ES 934 EC	**BASIC ELECTRONICS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	**30**	**70**	**3**

Course Objectives

- Analyze the behavior of semiconductor diodes in Forward and Reverse bias.
- Design of Half wave and Full wave rectifiers with L, C, and LC & CLC Filters.
- Explore V-I characteristics of Bipolar Junction Transistor n CB, CE & CC configurations.
- Explain feedback concept and different oscillators.
- Analyze Digital logic basics and Photo Electric devices.

Course Outcomes

- Explain VI characteristics of Semiconductor diode, BJT, FET and MOSFET
- Calculate ripple factor, efficiency and % regulation of rectifier circuits
- Analyze feedback amplifiers, BJT oscillator circuits, Opamp, basic digital logic gates and data acquisition system

UNIT-I

Semi Conductor Theory: Energy Levels, Intrinsic and Extrinsic Semiconductors, Mobility, Diffusion and Drift current. Hall Effect, Characteristics of P-N Junction diode, Parameters and Applications

Rectifiers: Half wave and Full wave Rectifiers (Bridge, center tapped) with and without filters, ripple regulation and efficiency. Zener diode regulator.

UNIT-II

Bipolar Junction Transistor: BJT, Current components, CE, CB, CC configurations, characteristics, Transistor as amplifier. Analysis of CE, CB, CC Amplifiers (qualitative treatment only).

JFET: Construction and working, parameters, CS, CG, CD Characteristics, CS amplifier.

UNIT-III

Feedback Concepts – Properties of Negative Feedback Amplifiers, Classification, Parameters.

Oscillators – Barkhausen Criterion, LC Type and RC Type Oscillators and Crystal Oscillators. (Qualitative treatment only)

UNIT-IV

Operational Amplifiers – Introduction to OP Amp, characteristics and applications –Inverting and Non-inverting Amplifiers, summer, Integrator, Differentiator, Instrumentation Amplifier.

Digital Systems: Basic Logic Gates, half, Full Adder and Subtractors.

UNIT-V

Data Acquisition systems: Study of transducer (LVDT, Strain gauge, Temperature, Force). **Photo Electric Devices and Industrial Devices:** Photo diode, Photo Transistor, LED, LCD, SCR, UJT Construction and Characteristics only.

Display Systems: Constructional details of CRO and Applications.

Suggested Reading:

1. Jocob Millman, Christos C. Halkias and Satyabrata Jit, **Electronics Devices and Circuits,** 3rd edition, McGraw Hill Education(India) Private Limited, 2010.
2. Rama Kanth A. Gaykward, **Op-AMPS and Linear Integrated Circuits** 4th Edition Prentice Hall of India, 2000.
3. M. Morris Mano, **Digital Design**, 3rd Edition, Prentice Hall of India, 2002.
4. William D Cooper, and A.D. Helfrick, **Electronic Measurements and Instrumentations Techniques**, 2nd ed., Prentice Hall of India, 2008.
5. S. Shalivahan, N. Suresh Kumar, A. Vallava Raj, **Electronic Devices and Circuits**, 2nd ed., McGraw Hill Education(India) Private Limited, 2007.

Course Code	Course Title						Core / Elective
PC 401 ME	**APPLIED THERMODYNAMICS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	4	-	-	-	**30**	**70**	**4**

Course Objectives

- To study the application of thermal science in mechanical engineering, consisting of the fundamental laws and processes for energy conversion.
- To understand thermal design aspects of reciprocating machinery-reciprocating compressors and IC Engines.
- To analyse Rankine cycle applied to thermal power plants and its improvements.
- To gain the knowledge on the power plant thermal devices-Boilers, Condensers, Pumps &Nozzles.

Course Outcomes

- Expected to be able to quantify the behavior of reciprocating compressors.
- Expected to be able to explain thermal design and working principles of IC Engines,their supporting systems and Combustion chambers.
- Expected to be able to quantify the behavior of power plants based on the Rankine cycle, including the effect of enhancements such as superheat, reheat and regeneration.
- Expected to be able to explain the thermal design and working principles of Power plant devices - Boilers, Condensers, Pumps &Nozzles.

UNIT-I

Reciprocating Air Compressors: Classification and applications. Ideal and actual P-V diagrams, work input and efficiency relations for single and multi stage compressors. Effect of clearance volume on work input and efficiency. Inter cooling and after cooling concepts.

UNIT-II

Internal Combustion Engines: Classification and applications. Working principles of four stroke and two stroke engines, Spark Ignition and Compression ignition engines. Deviation of actual cycles from Air Standard cycles. Performance parameters of I.C. Engines. Heat balance sheet of I. C. Engine. Overview of Engine supporting systems- Cooling Systems, Lubrication systems- Wet sump, Dry sump and Mist Systems. Working principles of S.I. Engine fuel systems- Carburetors, Battery and Magneto Ignition systems. Working principles of C.I. Engine fuel systems- Fuel pump and Fuel injector.

UNIT-III

I.C. Engine Combustion phenomena: Stages of combustion in S.I. Engines- Ignition delay, Flame front propagation and After burning. Abnormal combustion- Pre-ignition and Knocking. Factors affecting Knocking. Stages of combustion in C.I. Engines, Delay period, Period of Uncontrolled Combustion, Period of Controlled Combustion and after burning. Abnormal Combustion-Knocking. Factors affecting Knocking. Octane and Cetane rating of fuels. Design considerations for combustion chamber and cylinder head. Type of combustion chambers of S.I. engines and C.I. engines.

UNIT-IV

Steam Boilers: Classification and Working Principles. Water tube boilers- Babcok & Wilcox and Stirling boilers. Fire tube boilers- Cornish, Cochran, Locomotive and Lancashire boilers. High Pressure boilers / Supercritical boilers: La mont, Benson boiler, Loeffler boiler and Velox boiler. Boiler Mountings and Accessories: Working Principles of Water level indicator, Pressure gauge, Steam stop valve, Feed check valve, Blow-off cock, Fusible plug, Safety valves, Economizers, Superheaters and Steam separator. **Steam Condensers:** Jet and Surface condensers, Principle of Operation and Applications.

UNIT-V

Steam Power Plant Cycles: Carnot and Rankine cycles of operation and their efficiencies. Analysis of Rankine cycle with superheating, reheating and regeneration (Direct and Indirect types). Steam Nozzles: Flow of steam through convergent - divergent nozzles, velocity of steam flowing through the nozzle, mass of steam discharge through the nozzle, condition for maximum discharge, critical pressure ratio and nozzle efficiency. Super saturated expansion of steam through nozzles. General relationship between area, velocity and pressure in Nozzle flow.

Suggested Reading:

1. R.K. Rajput, " **Thermal Engineering**", Laxmi Publications, 9th Edn., 2013
2. V. Ganesan, "**Internal Combustion Engines**", Tata McGraw Hill Publishing, 2007
3. P.L. Ballaney, "**Thermal Engineering**", Khanna Publishers, 19th Edn., 1993.
4. Richard Stone, "**Introduction to I.C. Engines**", Mac Millan, 2nd Edn., 1997

Course Code	Course Title						Core / Elective
PC 402 ME	**KINEMATICS OF MACHINES**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	4	1	-	-	**30**	**70**	**4**

Course Objectives

- To understand the basic elements of machinery and their motion characteristics
- To know the kinematic properties of mechanisms and machines
- To understand basic machine elements
- To know classification and applications of cams, gears and gear-trains

Course Outcomes

- To determine the degree of freedom of a given mechanical system.
  To understand the importance of mechanisms and their applications.
- To develop new mechanisms for various applications.
- To develop a power drive system for a specific system.
- To understand the importance of friction and its applications.

UNIT-I

Definition of link, element, pair, kinematic chain, mechanism and machine, Grubler's criterion, single and double slider chains, inversions of quadratic cycle chain, inversions of single and double slider crank chains. Fundamentals of coupler curves, Robert's law, mechanism with lower pairs and straigh line motion mechanism, Pantograph, Peaucerlier, Hart, Davis and Ackerman's Steering gear mechanisms

UNIT-II

Analysis of Mechanisms: Graphical methods to find velocities of mechanisms, instantaneous centre, body centre and space centre, Kennedy's theorem, Graphical determination of acceleration of different mechanisms including Coriolis component of acceleration. Analytical method to find the velocity and acceleration, analysis of four bar mechanism with turning parts, Freudenstein's method for four bar linkage synthesis.

UNIT-III

Laws of Friction: Friction in screw threads, pivots, collars and clutches, friction axis of link and friction circle

Belts and Ropes: Open and closed belt drives, length of belt, ratio of tensions, effect of centrifugal tension and initial tension over power transmission, condition for maximum power
Brakes and Dynamometers: Block or shoe, band and block, internal expanding shoe brake, Prony, Rope brake, belt transmission, Torsion dynamometers.

UNIT-IV

Cams: Types of cams and followers, Displacement diagrams for followers, uniform motion, parabolic motion, simple harmonic motion, cycloidal motion drawing cam profile with knife-

edge follower, translating roller follower and translating Flat follower, cams of specified contour: Eccentric circle cam with translating flat power, Eccentric circle cam with translating roller follower.

UNIT-V

Gears: Classification of gears. Spur gears- Nomenclature, law of gear tooth action, involute as gear tooth profile, interference of involute gears, minimum number of teeth to avoid interference, contact ratio, cycloidal tooth profile, comparison of involute and cycloidal tooth profile.

Helical gears: Helical gear tooth relations, contact of helical gear teeth. Gear trains- Simple and compound, reverted, and epicyclic gear trains.

Suggested Reading:

1. S.S. Rattan, **Theory of Machines**, Tata McGraw-Hill, 3rd Edition, 2009.
2. J. E. Shigley, **Theories of Machines**, McGraw-Hill Publications, 2005.
3. Thomas Bevan, **Theory of Machines**, CBS Publishers,
4. J.S. Rao and R.V. Dukkipati, "**Mechanisms and Machine Theory**", Wiley Eastern Limited, 1992.
5. Amitabha Ghosh and Ashok Kumar Mallik, **Theory of Mechanisms and Machines**, East West Press Pvt. Ltd, 2008

Course Code	Course Title						Core / Elective
PC 403 ME	**DESIGN OF MACHINE ELEMENTS**						
Prerequisite	Contact Hours per Week				CIE	SEE	Core
	L	T	D	P			Credits
NIL	4	-	-	-	**30**	**70**	**4**

Course Objectives

- To understand the basics of mechanics of materials and design of a machine for static and fatigue strength, rigidity and wear criterions use of codes and standards.
- To know the principles of ergonomic design and use of theories of failure for safe design
- To learn the principles to design shafts, keys, belt drives, joints and couplings.

Course Outcomes

- To select proper material for the machine component based on theories of failure, different fatigue loads.
- To determining size of the machine components for torque transmission, bending and axial loads.
- To identify the type of joints and fasteners required for a given application and predicting its efficiency

UNIT-I

Design considerations of Machine Elements. Materials used in machine design and their specifications according to Indian Standards. Codes and standards used in design. Important mechanical properties of materials used in design. Preferred numbers. Manufacturing considerations in design. Review of types of loads and simple stresses. Stresses due to Biaxal and Triaxal loads. Factor of safety. Theories of failures. Design of components subjected to impact loading.

UNIT-II

Design for Fatigue: Fluctuating stresses, fatigue strength and endurance limit Stress concentration factor and Notch sensitivity. Factors affecting fatigue strength. S-N diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue - Miner's rule.

UNIT-III

Design of shafts: solid, hallow and splined shafts under torsion and bending loads. Design of keys. Design of couplings - Muff, Split muff, Flange, Flexible, Marine type couplings.

UNIT-IV

Design of Joints: Cotter and Knuckle joints. Design of pulleys. Design of chain drives linked and laminated chains. Design of bolts and nuts, Locking devices for nuts, Bolts of uniform strength. Bolted joints under eccentric loads. Design of gasket joints.

UNIT-V

Design of Screws: Design of power Screws and screw jack. Differential and Compound Screws. Design of rivetted and welded joints under direct and eccentric loads.

Suggested Reading:

1. M.F. Spotts, "**Design of Machine Elements**", Pearson Edu, 7th edn. 2003.
2. V. B. Bhandari, "**Design of Machine Elements**", Tata McGraw-Hill Publ, 3rd Edn. 2010.
3. P.C. Sharma & D.K. Aggarwal, "**Machine Design**", S.K. Kataria & Sons, 10th edn, 2003.
4. P. Kannaiah, **Machine Design,** Sci-Tech Publ., 2009.
5. J.E. Shigley & Charles R. Mischke "**Mechanical Engineering Design**", Tata McGraw-Hill., 6th ed. 2010.

Course Code	Course Title						Core / Elective
ES 461 EE	**ELECTRICAL CIRCUITS AND MACHINES LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	**25**	**50**	**1**

Course Objectives

- To learn practical electric AC & DC circuits
- To learn operation and performance characteristics of electrical machines by conducting various tests practically

Course Outcomes

- Aware of various electric safety rules to be followed while working with electric circuits and equipments
- Explore themselves in designing basic electric circuits
- Identify requirements for electric machines for domestic and industrial purpose

List of Experiments:

1. Verification of Kirchhoff's Laws.
2. Verification of Thevenin's and Norton's Theorems.
3. Study of Three-Phase Balanced Circuits.
4. Measurement of Power by Two-Wattmeter Method.
5. Study of Single-Phase RLC Series Circuits.
6. Magnetization Curve of a Separately Excited DC Generator.
7. Load Characteristics of Shunt Generator.
8. Performance Characteristics of Shunt Motor.
9. Speed Control of DC Shunt Motor.
10. O.C and S.C Tests on Single-Phase Transformer.
11. Load Test on Single-Phase Transformer.
12. Load Test on Three-Phase Induction Motor.

Note: *At least ten experiments should be conducted in the Semester.*

Course Code	Course Title						Core / Elective
EC 955 EC	**BASIC ELECTRONICS LAB**						
Prerequisite	Contact Hours per Week				CIE	SEE	Core
	L	T	D	P			Credits
NIL	-	-	-	2	**30**	**70**	**1**

Course Objectives

- Demonstrate the characteristics of Semiconductor diodes
- Realize the filters and Rectifiers.
- Verify the characteristics of different transistor Configurations.
- Design of Biasing Circuits for BJT and FET Amplifiers.
- Design different circuits using Operational Amplifiers.

Course Outcomes

- Plot characteristics of diode and transistor
- Calculate ripple factor, efficiency and % regulation of rectifier circuits
- Analyze feedback amplifiers and BJT oscillator circuits
- Demonstrate Opamp, data converter and strain gauge measurement

List of Experiments:

1. CRO-Applications, Measurements of R, L and C using LCR meter, Color code method and soldering practice.
2. Characteristics of Semiconductors diode (Ge,Si and Zener)
3. Static Characteristics of BJT-Common Emitter
4. Static Characteristics of BJT-Common Base
5. Static Characteristics of FET
6. RC-Phase Shift Oscillator
7. Hartley and Colpitts Oscillators
8. Common Emitter Amplifier
9. Astable Multivibrator
10. Full-wave rectifier with and without filters using BJT
11. Operational Amplifier Applications
12. Strain Guage Measurement
13. Analog-to-Digital and Digital to Analog Converters

Note: *At least ten experiments should be conducted in the Semester.*

Suggested Reading:

1. Maheshwari and Anand, **Laboratory Experiments and PSPICE Simulations in Analog Electronics**, 1st edition, Prentice Hall of India, 2006.
2. David Bell A., **Laboratory Manual for Electronic Devices and Circuits**, Prentice Hall of India, 2001.

Course Code	Course Title						Core / Elective
PC 451 ME	**APPLIED THERMODYNAMICS LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	**25**	**50**	**1**

Course Objectives

- To understand applications of thermal engineering concepts through experimentation.
- To provide knowledge in testing of properties of fuels and lubricating oils
- To demonstrate and conduct experiments, Interpret and analyze data and report results of IC engine testing

Course Outcomes

- Perform experiments to find the efficiency of Petrol and Diesel engines.
- Find the properties of unknown fuels/lubricants.
- Perform experiments on CI and SI engines.
- Perform experiments on Reciprocating Air Compressor.

List of Experiments:

1.To determine volumetric efficiency, isothermal efficiency and mass flow rate of a two stage reciprocating air compressor.
2.To determine valve/ port timing diagram of a Petrol/Diesel engine.
3.To conduct performance test on single cylinder Diesel engine.
4.To conduct heat balance test on a Diesel engine.
5.To conduct Morse test on multi cylinder Petrol engine.
6.To conduct performance test on multi cylinder Petrol engine.
7.To conduct performance test on a two-stroke Petrol engine.
8.To conduct performance test on multi cylinder Diesel engine.
9.To study the performance of a Petrol engine under different compression ratios.
10.Exhaust gas analysis of Petrol engine for carbon-monoxide and unburnt hydrocarbons.
11.Exhaust gas analysis of Diesel engine for carbon deposits using smoke meter.
12.Determination of viscosity of lubricating oil.
13.Determination of flash and fire points of a fuel

Note: *At least ten experiments should be conducted in the Semester.*