Semester

V

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Design of Machine Elements I	**Course Code**: MEUL501	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite.	1
2	**Materials:** Mechanical Properties and IS coding of various materials, Selection of material from properties and economic aspects. **Manufacturing Considerations in Design**: Standardization, Interchangeability, limits, fits tolerances and surface roughness, BIS codes, Design consideration for cast, forged and machined parts.	9
3	**Design for Strength**: Modes of failure, Strength and Stiffness considerations, Allowable stresses, factor of safety, **Stress concentration:** Causes and mitigations, fatigue failures. **Design of Members subjected to direct stress**: Knuckle and cotter joints.	10
4	**Design of Members in Bending**: Design of bell crank lever, lever loaded safety valve and rocker arm. **Laminated springs and its design.** **Design for stiffness of beam**: Use of maximum deflection formula for various end conditions for beam design.	8
5	**Design of Members in Torsion Shaft and Keys**: Design for strength, rigidity. Solid and hollow shafts. Shafts under combined loading. **Sunk keys; Couplings:** Design of muff coupling, clamp coupling, rigid flange coupling and Bushed-pin flexible coupling.	8
6	**Design of Threaded fasteners:** Bolt of uniform strength, Preloading of bolts: Effect of initial tension and applied loads, Eccentric loading. **Design of lead screw and power screw.** **Design of members which are curved**: Crane hook, body of C clamp, machine frame.	9
	Total	**45**

Text Books:

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill.
2. Fundamentals of Machine Component Design, Juvinall R.C, and Marshek K.M, Willey
3. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication

Reference Books:

1. Mechanical Engineering Design, Richard G. Budynas, and J. Keith Nisbett, Tata McGraw Hill
2. Machine Design- an integrated approach Robert L. Norton, Pearson Education.
3. Theory & Problem of Machine Design (Schaum's Outline Series) Hall, Holowenko, Laughlin, Tata McGraw Hill

Prerequisite:

1. Engineering Mechanics, Mechanics of Solids, Theory of Machines
2. Material Science & Engineering
3. Machine Drawing Practice.

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Heat Transfer	**Course Code**: MEUL502	**Credit**: 3
Max Marks:100	**CIE:**40	**SEE:**60
End Term Exam Time:3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objectives, scope, course outcomes, and prerequisites of Heat Transfer.	1
2	**Conduction Heat Transfer:** General three-dimensional heat conduction equation in Cartesian, cylindrical, and spherical coordinates; types of boundary conditions; nature of governing differential equations; one-dimensional steady-state heat conduction with and without heat generation; electrical analogy; heat conduction through composite walls; critical thickness of insulation. **Heat Transfer from Fins:** Governing differential equation of a fin; fin efficiency and effectiveness for various boundary conditions.	11
3	**Convective Heat Transfer:** Introduction to convection: forced and free (natural) convection. Dimensional analysis of forced and free convection heat transfer; application and physical significance of Reynolds, Grashof, Prandtl, Nusselt, and Stanton numbers. Conservation equations of mass, momentum, and energy for two-dimensional incompressible flow; hydrodynamic and thermal boundary layers over a flat plate; empirical heat transfer correlations.	10
4	**Unsteady-State Heat Transfer:** One-dimensional transient conduction; lumped system analysis; transient solutions using Heisler charts. **Heat Transfer with Phase Change:** Nature of vaporization phenomena; regimes of boiling heat transfer; correlations for saturated pool boiling; condensation on flat plates; analysis of experimental correlations; dropwise condensation.	7
5	**Heat Exchangers:** Classification and types of heat exchangers; arithmetic mean and logarithmic mean temperature difference (LMTD); heat transfer coefficients for parallel-flow and counter-flow heat exchangers; effectiveness–NTU method; fouling factor; constructional and manufacturing aspects of heat exchangers.	8
6	**Thermal Radiation:** Planck's distribution law, Kirchhoff's law, radiation properties of surfaces; diffuse radiation; Lambert's law; radiation intensity; heat exchange between black bodies and grey bodies; shape factor (view factor); electrical analogy; heat transfer involving reradiating surfaces.	8
	Total	**45**

Text Books:

1. Heat and Mass Transfer, Dr. D. S. Kumar, S K Kataria and Sons
2. Heat and Mass transfer, Yunus A Cengel, Afshin J. Ghajar; McGraw Hill

Reference Books:

1. Heat Transfer, J Holman, Souvik Bhattacharyya; Mc Graw Hill
2. Heat and Mass transfer, P K Nag; McGraw Hill

Prerequisite:

1. Basics of Calculus & trigonometry.
2. Engg. Thermodynamics

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Manufacturing Technology	**Course Code**: MEUL503	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisites	1
2	**Machining:** Introduction, importance and scope of machining, classification of metal removal processes, concept of orthogonal and oblique cutting. Geometry of single point cutting tool and tool angles, Geometry of twist drill and plain milling cutter. Tool nomenclature in ASA system. Types of chips, mechanics of metal cutting, interrelationships between cutting forces, shear angle and shear strain. Thermal aspects of machining and measurement of chip tool interface temperature. Cutting fluids types, properties, selection and application methods.	10
3	**Machinability:** Concept of machinability and machinability index, factors affecting machinability. Different mechanisms of tool wear, types of tool wear (crater, flank). Concept of tool life, Taylor's tool life equation. Introduction to the economics of machining.	8
4	**Machine tools:** Classification of machine tools. Constructional features, working principle and estimation of machining time of lathe, drilling, shaping and milling machine Introduction to gear hobbing and broaching machine. Introduction to automatic lathe, capstan and turret lathe.	12
5	**Grinding and Finishing Processes:** Introduction and need of grinding. Types of grinding methods. Abrasives types (natural and synthetic). Types of bonds. Grinding wheels: configuration, properties, specifications and selection. Introduction to honing, lapping, and super-finishing processes.	6
6	**Unconventional Machining Processes:** Introduction to unconventional machining processes: USM, AJM, ECM, EDM, LBM & EBM. Concept and need of sustainable manufacturing.	8
	Total	**45**

Text Books:

1. P.N. Rao, Manufacturing Technology, Vol. 2, 4e, McGraw Hill Education,2018.
2. P.C. Sharma, A Textbook of Production Technology (Manufacturing Processes, 3e), S.Chand Publishing, 2016.

Reference Books:

1. Serope Kalpakjian and Steven R Schmid, Manufacturing Engineering and Technology, 8e, Pearson Education, Asia, 2023.
2. A.B. Chattopadhyay, Machining and Machine Tools,2e, Wiley India Pvt. Ltd., 2017.
3. Amitabh Ghosh and Amit Kumar Mallik, Manufacturing Science, Affiliated East West Press (p) Ltd, New Delhi, 2010.

Prerequisite:

1. Basic knowledge of mathematics
2. Basics of manufacturing processes.

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Mechatronics and Robotics	**Course Code**: MEUL504	**Credit**: 2
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (30) + TW & SL(30) = 60 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Overview of Mechatronics:** Historical perspective, Definition, Applications, Block diagram of Mechatronic system, Functions of Mechatronics Systems, Benefits of mechatronics in manufacturing. Signal Conditioning, Data Acquisition systems.	4
3	**Overview of Robotics:** Brief History, Basic Concepts of Robotics such as Definition, Three laws, Elements of Robotic Systems i.e. Robot anatomy, DOF., Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc. End effectors	4
4	**Sensors and Actuators:** Static characteristics of sensors and actuators, Position, Displacement and Proximity Sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors, Actuators: Electrical Actuators (Solenoids, Relays, DC motor, Servo motor, BLDC motor, AC motor, Stepper motors), Hydraulic and Pneumatic actuators	10
5	**Robotic Vision:** Architecture of robotic vision system, Image acquisition and processing, Industrial applications of Vision controlled robotic systems **Robot Applications:** Industrial applications; Assembly, Inspections, Material handling, other applications, Robot safety	5
6	**Introduction to Microprocessors and Microcontrollers; Programmable Logic Controllers (PLCs):** Architecture, Number Systems Basics of PLC Programming, Logics, Timers and Counters, **Case Studies:** Design of pick and place robot, Car engine management system, Automated manufacturing system, Automatic camera, Automatic parking system, Safety devices and systems	6
	Total	**30**

Text Books:

1. Bolton, W . Mechatronics. Pearson Education India.
2. Mittal R.K. and Nagrath I.J., Robotics and Control, Tata McGraw-Hill Education.

Reference Books:

1. Rajput, R. K. A textbook of Mechatronics. S. Chand Publishing
2. Bishop, R. H. The mechatronics handbook-2 volume set. CRC press.
3. Peter, C. Robotics vision and control. Fundamental Algorithms in MATLAB. Springer, Berlin.
4. Niku, S. B. Introduction to robotics: analysis, systems, applications (Vol. 7). New Jersey: Prentice hall.

Prerequisite:

1. Engineering Mechanics
2. Basic Concept of Electronics

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Quality Control & Reliability	**Course Code**: MEUL511	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	The overview of Quality: History of quality, quality improvement, dimensions of quality, quality control, quality of design and quality of conformance, quality policy and objectives, economics of quality.	3
	Modeling process in quality control: Describing variation, frequency distribution, probability distributions, pattern of variation, Inferences about process quality: sampling distributions and estimation of process parameters. Analysis of variance.	5
3	**Statistical Quality Control:** Concept of SQC, Chance and assignable causes of variation, statistical basis of control chart, basic principles, choice of control limits, sample size and sampling frequency, The magnificent seven.	4
	Control chart for variables: X-bar and R charts, X-bar and S charts, control chart for individual measurement. Application of variable control charts.	6
4	**Control chart for attributes:** control chart for fraction non-conforming P-chart, np-chart, c-chart and u-chart. choice between attribute and variable control chart. SPC for short production runs. Process capability analysis using histogram and probability plot, capability ratios and concept of six sigma.	8
5	**Quality Assurance:** Concept, advantages, field complaints, quality rating, quality audit. Introduction to Quality systems like ISO 9000 and ISO 14000.	4
	Acceptance Sampling: Fundamental concepts in acceptance sampling, operating characteristics curve. Acceptance sampling plans, single, double and multiple sampling plans, LTPD, AOQL, AOQ.	4
	Introduction to Taguchi Method of Design of Experiments, Quality loss function.	3
6	**Reliability and Life Testing-** Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations. Introduction to Availability and Maintainability, replacement of items.	6
7	Introduction to use of IoT, AI& ML and Big data analytics in quality control.	1
	Total	**45**

Text Books:

1. Introduction to Statistical Quality Control, Douglas C. Montgomery, 2nd Edition, Wiley.
2. An introduction to reliability and maintainability engineering, Charles E. Ebeling, Tata McGraw-Hill

Reference Books:

1. Quality Planning and Analysis, J.M. Juran and F.M. Gryna, McGraw Hill
2. Quality Control, Dale H. Bester field, 8th Edition, Pearson/Prentice Hall 2008
3. Statistical Quality Control, E. L. Grant and Richard S. Leavenworth, Tata McGraw-Hill
4. Fundamentals of Quality Control and Improvement, Amitava Mitra, 2nd Edition, Prentice Hall
5. Design and Analysis of Experiments, 5th Edition, Douglas C. Montgomery, Wiley-India

Prerequisite:

1. Students should have the basic knowledge in mathematics and statistics.

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Automobiles & Electric Vehicles	**Course Code**: MEUL512	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Frame & Body:** Layout of chassis, types of chassis frames and bodies, their constructional features and materials. Clutches: single plate, multi-plate, cone clutch, semi centrifugal, electromagnetic, vacuum and hydraulic clutches. Fluid coupling. Brakes: Classification and function; Mechanical, hydraulic, vacuum air and self-engineering brakes; Brake shoes and lining materials, ABS system.	9
3	**Gear Boxes:** Sliding mesh, constant mesh, synchromesh and epicyclic gear boxes, Automatic transmission system; Hydraulic torque converter; Drives: Overdrive, Propeller shaft, Universal joints, Differential; Rear axle drives. Hotchkiss and torque tube drives; Rear axle types; Front wheel and All wheel drive. Wheels and Tyres: Tyre types, Tyre construction; Tyre inflation pressure, Tyre wear and their causes.	10
4	**Steering system:** Steering gear boxes, steering linkages, Steering mechanism, Under and Over steering. Steering Geometry, Effect of camber, caster, king pin inclination, toe in and toe out; Power steering; Integral and linkage types Suspension system: objective and requirements, Suspension spring, front and rear suspension systems, Independent suspension system Shock absorbers	9
5	**Automotive Electrical System:** Battery construction, Charging and testing, battery types, Starting and Battery Charging System: Starter motor construction, types of drive, Alternator construction, regulation and rectification. Ignition System: Magneto and coil ignition systems Automotive Air Conditioning: Introduction, Loads, Air conditioning system Components, Refrigerants, Fault Diagnosis.	10
6	**Electric Vehicles:** Components of Electric Vehicle, General Layout of EV. EV classification, Battery Electric Vehicles (BEVs), Fuel-Cell Electric Vehicles (FCEVs) Comparison with Internal Combustion Engine: Technology, Advantages & Disadvantages of EV, National Policy for adoption of EVs, Overview of Tesla car. Automotive Safety: Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision System) GPS (Global Positioning System).	6
	Total	**45**

Text Books:

1. Automobile Engineering by R. K. Rajput
2. Automobile Engineering P.S. Gill Katson Publication
3. Electric Vehicle Engineering by Per Enge (Tata McGraw)

Reference Books:

1. Automobile Engineering Kirpal Singh Standard Publications
2. Automobile Engineering- RP Sharma Dhanpat Rai & Sons

Prerequisite:

1. Basic concept of engineering mechanics.
2. Basic concepts of electrical engineering.

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Power Plant Engineering	**Course Code**: MEUL513	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Coal Based Thermal Power Plants**: Rankine cycle — improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants — Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.	8
3	**Diesel, Gas and Combined Cycle Power Plants**: Otto, Diesel, Dual & Brayton Cycle — Analysis & Optimization. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.	9
4	**Renewable Energy -** Principle, Construction and working of Hydro Electric Power Plants, Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.	9
5	**Nuclear Power Plant**: Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Canada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.	9
6	**Energy, Economic and Environmental Issues of Power Plants:** Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants, Power tariff types. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants	9
	Total	**45**

Text Books:

1. P.K. Nag, "Power Plant Engineering", McGraw Hill Publications.
2. Arora and Domkundwar, "A Course in Power Plant Engineering", Dhanpat Rai and Co.

Reference Books:

1. R.K. Rajput, "A Textbook of Power Plant Engineering", Laxmi Publications.
2. P.C. Sharma, "Power Plant Engineering", S. K. Kataria and Sons.
3. G.D. Rai, "Non-Conventional Energy Resources", Khanna Publishers.

Prerequisite:

1. Engineering Thermodynamics
2. Basics of Mechanical Engineering
3. Engineering Chemistry

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Heat Transfer lab	**Course Code**: MEUP520	**Credit**: 1
Max Marks: 100	**CIE:** 60	**SEE:** 40
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 0L+0T+2P	

S. No.	Experiment Title	Hours
1.	Introduction: Objective, Scope, Outcome of the Course and Prerequisite.	1
2.	Experimental determination of the thermal conductivity of glass wool (industrial insulating material) using the concentric sphere method.	3
3.	Experimental determination of the thermal conductivity of hylam using the guarded hot plate method.	2
4.	Determination of the overall heat transfer coefficient of a composite wall and comparison with theoretical values.	2
5.	Experimental determination of the heat transfer rate and temperature distribution of a pin fin under forced convection.	4
6.	Experimental determination of the convective heat transfer coefficient for natural convection from vertical/ horizontal pipe.	2
7.	Experimental determination of the convective heat transfer coefficient for forced convection from horizontal pipe.	2
8.	Determination and comparison of surface heat transfer coefficients for: (i) Dropwise condensation (ii) Filmwise condensation	4
9.	Evaluatethe bubble formation in pool boiling and plotting the heat flux versus bulk temperature curve up to the critical heat flux (burnout) condition.	2
10.	Study and comparison of parallel-flow and counter-flow heat exchangers for LMTD and effectiveness-NTU.	2
11.	Experimental determination of the Stefan–Boltzmann constant.	2
12.	Experimental determination of the emissivity of an aluminium plate using the comparison method.	4
	Total	**30**

Text Books:

3. Heat and Mass Transfer, Dr. D. S. Kumar, S K Kataria and Sons
4. Heat and Mass transfer, Yunus A Cengel,Afshin J. Ghajar; Mc Graw Hill

Reference Books:

3. Heat Transfer, J Holman, Souvik Bhattacharyya; Mc Graw Hill
4. Heat and Mass transfer, P K Nag; Mc Graw Hill

Prerequisite:

1. Basics of Calculus & trigonometry.
2. Engg. Thermodynamics

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Machine Design Practice I	**Course Code**: MEUP521	**Credit**: 1
Max Marks: 100	**CIE:** 60	**SEE:** 40
End Term Exam Time: 3 Hrs.	**Teaching Scheme:** 0L+0T+2P	

S. No.	Contents	Hours
1.	Introduction: Objective, Scope, Outcome of the Course and Prerequisite.	1
2.	Material selection and relevant BIS nomenclature.	1
3.	Selecting fit and assigning tolerances	2
4.	Design of Knuckle and Cotter Joints	4
5.	Design of Beams and Levers	4
6.	Design of Shaft and Keys	4
7.	Design of Couplings	4
8.	Design of Screw Fastening	4
9.	Design Software Applications: Part modelling of Knuckle and Cotter Joints, Shafts, Coupling, etc. using Creo and simulation using ANSYS	6
	Total	**30**

Text Books:

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill.
2. Fundamentals of Machine Component Design, Juvinall R.C, and Marshek K.M, Willey
3. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication

Reference Books:

1. Mechanical Engineering Design, Richard G. Budynas, and J. Keith Nisbett, Tata McGraw Hill
2. Machine Design- an integrated approach Robert L. Norton, Pearson Education.
3. Theory & Problem of Machine Design (Schaum's Outline Series) Hall, Holowenko, Laughlin, Tata McGraw Hill

Prerequisite:

1. Engineering mechanics and mechanics of solids
2. Material science and engineering
3. Machine drawing practice
4. Theory of machines

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Measurement & Metrology Lab	**Course Code**: MEUP522	**Credit**: 1
Max Marks: 100	**CIE:** 60	**SEE:** 40
End Term Exam Time: 3 Hrs.	**Teaching Scheme:** 0L+0T+2P	

Module No.	Contents	Hours
1	Introduction: Objective, Scope, Outcome of the Course and Prerequisite.	2
2	To measure external and internal dimensions of given components using vernier caliper, micrometer, slip gauges and telescopic gauges and dial bore indicator.	4
3	To measure taper angle using bevel protractor and sine-bar.	2
4.	To measure effective diameter of screw thread parameters using three-wire method.	2
5	To measure gear tooth thickness by using a gear tooth vernier.	2
6	To check accuracy of a gear profile with the help of profile projector.	2
7	To plot the composite errors of a given set of gears using composite gear tester.	2
8	To measure flatness and surface defects in the given test piece with the help of monochromatic light and optical flat.	2
9	To check the flatness of a machined, ground and lapped flat surface using dial gauge.	2
10	To measure surface roughness of a given part using surface tester.	2
11	To measure tool angles of a single point cutting tool using tool makers microscope.	2
12	To measure the coating thickness on given parts using coating thickness gauge.	2
13	To measure hardness for rubber and plastic components using Shore's durometer.	2
14	To perform alignment test on a centre lathe machine.	2
	Total	**30**

Text Books:

1. Raghavendra, N. V. and Krishnamurthy L., Engineering metrology and measurements, Oxford University Press, New Delhi, 2017.

Reference Books:

1. R. K. Jain, Engineering Metrology, Khanna Publishers, New Delhi, 2022
2. N.V. Raghavendra& L. Krishnamurthy, Engineering Metrology & Measurements, Oxford University Press, India, 2013

Prerequisite:

1. Basic concepts of Physics & Mathematics (Secondary level).

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Mechatronics and Robotics Lab	**Course Code**: MEUP523	**Credit**: 1
Max Marks: 100	**CIE:** 60	**SEE:** 40
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 0L+0T+2P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite.	1
2	**Transducers Kit** • Characteristics of LVDT • Characteristics Reflective Opto Transducer	5
3	**PLC Programming** • Ladder programming on logic gates, timers and counters • Ladder programming for traffic light control, water level control modules	6
4	**Mobile Robot** • Basics of Arduino, Raspberry pi platforms and its applications • Program for Operating Motion and Direction control • Program for Operating White line follower for the given arena	6
5	**Robotics Programming for Applications** • Robot programming and simulation of pick and place tasks • Robot programming for motion control using firebird robot • Programming of humanoid robot for different movements • Robot programming and simulation for colour and shape identification.	12
	Total	**30**

Text Books:

1. Bolton, W . Mechatronics. Pearson Education India.
2. Mittal R.K. and Nagrath I.J., Robotics and Control, Tata McGraw-Hill Education

Reference Books:

1. Rajput, R. K. A textbook of Mechatronics. S. Chand Publishing
2. Bishop, R. H. The mechatronics handbook-2 volume set. CRC press.
3. Peter, C. Robotics vision and control. Fundamental Algorithms in MATLAB. Springer, Berlin.
4. Niku, S. B. Introduction to robotics: analysis, systems, applications (Vol. 7). New Jersey: Prentice hall.

Prerequisite:

1. Engineering Mechanics
2. Basic Concept of Electronics

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: V
Course Name: Industrial Training	**Course Code**: MEUT530	**Credit**: 2
Max Marks: 100	**CIE:**60	**SEE:**40
End Term Exam Time: 3 Hrs.	**Teaching Scheme:** 0L+0T+4P	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	Report writing, Power-point Presentation by students based on 45 days Industrial Training after IV semester.	59
	Total	**60**

Prerequisites:

1. Basic engineering knowledge, knowledge of core mechanical engineering courses, computer-aided design (CAD) skills and understanding of manufacturing processes.
2. Awareness of professionalism, work ethic and safety procedures and protocols in industrial environment.

Semester

VI

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Design of Machine Elements II	**Course Code**: MEUL601	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Fatigue Considerations in Design**: Variable load, loading pattern, S-N Diagram, ,Endurance limit and Fatigue failure, Factors affecting endurance limit, Stress Concentration, Fluctuating stresses, Soderberg, Goodman and Modified Goodman criteria, Combined stresses, design of members for infinite and finite life.	8
3	**Design of elements under fluctuating stresses:** bolts, helical compression, tension and torsional springs.	8
4	**Design of power transmission elements:** belts, gears, force analysis of spur, helical, bevel and worm gears. Lewis and Buckingham equations, wear and dynamic load considerations.	10
5	**Design of anti-friction bearings**: Selection of anti-friction bearings for different loads and load cycles, Mounting of the bearings, Method of lubrication. **Design of Sliding and Journal Bearing:** Methods of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum film thickness and thermal equilibrium.	10
6	**Design of IC Engine components**: Piston, Cylinder, Connecting Rod and Crank Shaft.	8
	TOTAL	**45**

Text Books:

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill.
2. Fundamentals of Machine Component Design, Juvinall R.C, and Marshek K.M, Willey
3. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication

Reference Books:

1. Mechanical Engineering Design, Richard G. Budynas, and J. Keith Nisbett, Tata McGraw Hill
2. Machine Design- an integrated approach Robert L. Norton, Pearson Education.
3. Theory & Problem of Machine Design (Schaum's Outline Series) Hall, Holowenko, Laughlin, Tata McGraw Hill

Prerequisite:

1. Engineering mechanics and mechanics of solids
2. Material science and engineering
3. Machine drawing practice
4. Theory of machines

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Industrial Engineering & Management	**Course Code**: MEUL602	**Credit**: 2
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (30) + TW & SL(30) = 60 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Management Theory and Functions:** History and development of scientific management thoughts. Contribution of Taylor, Fayol, Mayo to scientific management. Levels of Management Administration and Functions of Management. **Business Forms and Organization:** Forms of Business:(i) Single proprietorship (ii) Partnership (iii) Joint stock company (iv) Private Ltd- Companies and public limited companies. Organization meaning, types of organization, (i) Line organization (ii) Functional Organization (iii) Line Staff organization (iv) Line Staff Committee organization, span of control.	7
3	**Human Resource Management:** Motivation, Morale and Behavioural Science, Job Analysis, Job Evaluation, Wages and Incentives, Compensation. Participative Management and Group Decision Making, Industrial Relations, Trade Union and Collective Bargaining.	5
4	**Work study**: Techniques of work study, basic procedure, approach to method study, method study charts and diagrams, principles of motion economy. **Work measurement:** Basic procedure, techniques: Stop watch time study and work sampling, rating, determination of standard time.	6
5	**Depreciation:** Causes, Basic methods of computing depreciation charges; Straight line, Sinking fund, Declining Balance and Sum of year's digits method. **Breakeven analysis:** Basic concepts, Linear Breakeven analysis for single product, Breakeven charts, Dumping.	6
6	**Labour Relations and Legislation:** Profit sharing, fringe benefits etc. Trade Unions, Methods of setting disputes (i) Collective bargaining (ii) Conciliation (iii) Mediation (iv) Arbitration industrial disputes in India, Machinery for setting disputes, Trade Disputes Acts, The factory Act 1944, payment of wages act, Workman's compensation act, Environment protection Act, 1986, Occupational safety, health and working conditions code, 2020.	5
	Total	**30**

Text Books:

1. O. P. Khanna, Industrial Engineering and Management, Dhanpatrai Publications
2. B. Kumar, Industrial Engineering and Management, Khanna Publishers
3. Basu S.K., Sahu K.C., Datta N.K., Works Organisation and Management, Oxford and IBH.

Reference Books:

1. Dexter S. Kimball, Principles of Industrial Organization, Read Books.
2. Leon Pratt Alford, Henry Russell Beatty, Principles of Industrial Management, Revised Edition, Ronald Press Co.
3. George Kanawaty, Introduction to Work Study, ILO

Prerequisite:

1. Basic Mathematics.
2. Basic knowledge about industrial environment.

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Mechanical Vibrations	**Course Code**: MEUL603	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction to Sound:** Frequency dependent human response to sound, Sound pressure dependent human response, Relationship between sound power, sound intensity and sound pressure levels. **Introduction to Noise:** Auditory and Non auditory effects of Noise, Major sources of the noise, Industrial noise sources, Industrial noise control strategies. Introduction to Vibration: Importance and scope of vibrations, terminology and classification, Concept of Degrees of freedom, Harmonic motion, vectorial representation, complex number representation, addition.	8
3	**Undamped Single Degree of Freedom Systems:** Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations without damping using Newton's second law, D' Alembert's principle and Principle of conservation of energy. Compound pendulum and centre of percussion. **Damped vibrations of single degree of freedom systems:** Viscous damping, under-damped, critically damped and over-damped systems, Logarithmic decrement. Vibration characteristics of Coulomb damped and Hysteretic damped systems.	8
4	**Forced Vibrations of Single Degree of Freedom Systems:** Forced vibration with constant harmonic excitation, Steady state and transient parts, Frequency response curves and phase angle plot, Forced vibration due to rotating and reciprocating imbalance, Forced vibration due to excitation of support. **Vibration Isolation and Transmissibility:** Force transmissibility, Motion transmissibility, Materials used in vibration isolation.	8
5	**Many Degrees of Freedom Systems (Exact analysis):** Principal modes of vibration, Equations of Motion, Matrix method, Eigen Values and Eigen Vectors, Using Lagrange's Equations to Derive Equations of Motion, Mode shapes, Influence Coefficients, Maxwell's reciprocal theorem. **Many Degrees of Freedom Systems (Approximate analysis):** Rayleigh's, Dunkerley's, Stodola's and Holzer's methods. Vibration Absorbers: Undamped dynamic vibration absorbers, Tuned vibration absorbers, centrifugal pendulum absorber. Critical Speed of Shafts: Critical speed of a light shaft without damping, secondary critical speed.	15
6	**Vibrations of continuous systems:** Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft.	5
	Total	**45**

Text Books:

1. Ambekar, A.G., "Mechanical Vibrations and Noise Engineering", PHI Learning Pvt. Ltd., New Delhi (2012)
2. Grover, G.K., "Mechanical Vibrations", Nem Chand and Bros. (2009)

Reference Books:

1. Rao, S.S, "Mechanical Vibrations", Pearson (2011)
2. Kelly, S.G., "Mechanical Vibrations, Theory and Applications", Cengage Learning (2013)

Prerequisite:

1. Engineering Mechanics and Strength of Materials.
2. Trigonometry, Matrix Algebra and Differential Equations.

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Computer Integrated Manufacturing Systems	**Course Code**: MEUL611	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time:	**Teaching Scheme:** CI (60) + TW & SL(60) = 120 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction to CIM:** Overview of Production Systems, the product cycle, Product Life Cycle, Different Types and Levels of Automation in Production Systems, CIM wheel, Numerical Control (NC): Basic components of an NC system, coordinate system and motions control systems. Computer Numerical Control (CNC): features of CNC, machine control unit, CNC software. Direct Numerical Control and Distributed Numerical Control. Applications, advantages and disadvantages of NC. Adaptive control of machining system.	6
3	**NC Part programming:** Manual and computer assisted part programming, Part programming with APT. NC part programming using CAD/CAM software. Standardized & Non standardized canned cycles, NC cutter path verification.	10
4	**Computer Aided Process Planning:** Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data systems, computer generated time standards. Group Technology: Introduction, part families, part classification and coding, coding system and machining cells.	8
5	**Computer Aided Production Management Systems:** Introduction to computer aided PPC, Introduction to computer aided inventory management, manufacturing resource planning (MRPII), computer process monitoring and shop floor control, computer process control, ERP. Computer Aided Quality Control; Computer in quality control, contact inspection methods, Non-contact inspection methods, optical and non-optical computer aided testing.	10
6	**Computer Aided Material Handling;** Computer control on material handling, conveying, picking. Ware house control, computerized material handling for automated inspection and assembly. **Computer Integrated Manufacturing Systems:** Introduction, types special manufacturing systems, flexible manufacturing systems (FMS): Introduction, Types and Layouts. Concurrent engineering, Collaborative Engineering; Introduction, Faster Design throughput, Web based design, Changing design approaches, extended enterprises, Agile and lean manufacturing.	10
	Total	**45**

Text Books:

1.Automation, Production Systems, and Computer-Integrated Manufacturing by Mikell P. Groover, Pearson Publication.

Reference Books:

1. CAD/CAM: Principles and Applications by PN Rao, Mc Graw Hill Publication.
2. CAD/CAM: Computer Aided Design and Manufacturing by Mikell P. Groover and E.W. Zimmers, Jr., Pearson Publication.

Prerequisite:

1. Basic knowledge of Manufacturing processes
2. Knowledge of Computer
3. Knowledge of mathematics and engineering fundamentals

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Additive Manufacturing	**Course Code**: MEUL613	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Overview of Rapid Product Development (RPD):** Need for the compression in product development, History of RP systems, Definition of RPD; Components of RPD. **Introduction to Additive Manufacturing:** Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM.	6
3	**Stereo Lithography Systems**: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application. **Selective Laser Sintering:** Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications. **Fusion Deposition Modelling**: Principle, Process parameter, Path generation, Applications. **Solid Ground Curing:** Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application. Selection of RP process; Issues in RP; Emerging trends.	15
4	**Rapid Tooling (RT):** Introduction to RT, Indirect RT process- Silicon rubber molding, Epoxy tooling, Spray metal tooling and Investment Casting, Cast kirksite, 3Q keltool, etc. **Direct RT processes**: Laminated Tooling, Powder Metallurgy based technologies, welding based technologies, Direct pattern making (Quick Cast, Full Mold Casting), Emerging Trends in RT,	8
5	**Reverse Engineering:** Geometric data acquisition, 3D reconstruction, Applications and Case Studies, Engineering applications, medical applications. **Processing Polyhedral Data:** Polyhedral B-Rep modeling, STL format, Defects, and repairof STL files, **Introduction to software for AM**: CURA and other software, Relevant G/M Codes, In-process monitoring, Calibration	10
6	**Post-Processing in Additive Manufacturing:** Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-Thermal and Thermal Techniques.	5
	Total	**45**

Text Books:

1. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2015.
2. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", Third edition, World Scientific Publishers, 2010.
3. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Nooran John Wiley & Sons 2006.

Reference Books:

1. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.
2. Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
3. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC Press, 2000

Prerequisite:

1. Knowledge of Materials Science and Engineering

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Refrigeration and Air Conditioning	**Course Code**: MEUL614	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction**: **Refrigeration and second law of Thermodynamics** Refrigeration effect and unit of Refrigeration, Heat pump, reversed Carnot cycle. Vapour Compression Refrigeration System: Analysis of simple vapour compression Refrigeration cycle by p-h and T-S diagram. Effect of operating conditions **Multi-pressure refrigeration systems:** Multistage and Compound compression, Multi evaporator systems and Cascade systems Refrigeration Equipment	14
3	**Refrigerants:** Classification, Nomenclature, selection of Refrigerants, global warming potential of CFC Refrigerants. **Non-conventional refrigeration systems (description only):** Simple vapour absorption system, Electrolux Refrigerator, Lithium Bromide Absorption Refrigeration System. Steam Jet refrigeration system, Vortex tube refrigeration system, ejector compression refrigeration system, thermo-electric refrigeration system	8
4	**Gas cycle Refrigeration:** Limitation of Carnot cycle with gas, reversed Brayton cycle, Brayton cycle with regenerative H.E. **Air cycle for air craft:** Necessity of cooling of air craft, Basic cycle and boot strap refrigeration cycle.	6
5	**Psychrometry:** Psychrometric properties, psychometric relations, psychrometric charts, psychrometric processes, cooling coils, By-pass factor, Apparatus Dew point temperature and air washers. **Human Comfort** Mechanism of body heat losses, factors affecting human comfort, effective temperature, comfort chart.	8
6	**Cooling load calculations:** Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling **Selection of air conditioning**: apparatus for cooling and dehumidification, Air conditioning system, year round air conditioning	8
	Total	**45**

Text Books:

1. Refrigeration and air conditioning by R.S. Khurmi& J.K. Gupta: S. Chand publisher
2. A Course in Refrigeration and Air- Conditioning published by Arora Domkundwar, Dhanpat Rai
3. Refrigeration & Air Conditioning by R.K. Rajput, Katson books

Reference Books:

1. Refrigeration and Air Conditioning by C. P. Arora: Mc Graw Hill Education
2. Principles of Refrigeration by Roy J Dossat: Pearson
3. ASHRAE hand book

Prerequisite:

1. Engineering Thermodynamic
2. Basic Mechanical Engineering

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Renewable Energy Technology	**Course Code**: MEUL615	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	**1**
2	**Energy Sources & Availability**: Conventional and non-conventional, renewable and non-renewable sources of energy, prospects and perspectives of renewable energy, Types of renewable energy sources, Global and National scenarios	8
3	**Solar Energy:** Solar radiation, its measurements and prediction, flat plate collectors, concentrating collectors, solar heating of buildings, solar still, solar water heaters, solar driers,. Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells, photovoltaic applications	10
4	**Wind Energy**: Classification, factors influencing wind, wind shear, turbulence, Betz limit, WECS- classification, characteristics, and applications.	8
5	**Biomass Energy**: Introduction to biomass, biofuels & their heat content, biomass conversion technologies. Aerobic & anaerobic digester, Factors affecting bio-digestion, biogas plants–types, description, utilisation of biogas, use of biogas in I.C. engines. Biomass gasification: Gasifier types, direct thermal application of gasifiers.	8
6	**Other Renewable Energy Sources**: Geothermal Energy: principle and systems. Hydrogen energy: types, production and storage. Fuel Cells: Principle & classification, polarization, advantage over batteries. Magneto Hydrodynamic (MHD) power conversion: Principle, closed & open cycle system, Tidal energy. Wave energy.	10
	TOTAL	**45**

Text Books:

1. G. D. Rai, “Non-Conventional Sources of Energy”, Khanna Publishers.
2. Solar Energy: Fundamental and Applications, H. P. Garg J Prakash, Tata McGraw-Hill.
3. S. P. Sukhatme and J. K. Nayak, “Solar Energy: Principles of Thermal Collection and Storage” Tata McGraw-Hill publishing Company limited

Reference Books:

1. Godfrey Boyle, “Renewable Energy” Oxford University Press
2. Solar Energy: Principles of Thermal Collection and Storage, S P Sukhatme, Tata McGraw-Hill.

Prerequisite:

1. Engineering Thermodynamics
2. Heat and mass transfer

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Finite Element Analysis	**Course Code**: MEUL616	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** CI (45) + TW & SL(45) = 90 hrs. per semester	

Module No.	Contents	Classroom Instruction (CI) Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	**1**
2	Introduction to FEA and its applicability, advantages of FEA, Review of Matrix algebra, Gauss elimination method, Banded symmetric matrix and bandwidth. Structure analysis: Two-force member element, Local stiffness matrix, Assembly, Global stiffness matrix, imposition of Boundary conditions, Properties of stiffness matrix.	8
3	**One-dimensional Finite Element Analysis:** Basics of structural mechanics, Principle of minimum Potential, General steps of FEA, Finite element model concept / Discretization, Derivation of finite elements equations using potential energy approach for linear and quadratic 1-D bar element, shape functions and their properties, Assembly, Boundary conditions, Computation of stress and strain.	8
4	**Two Dimensional Finite Element Analysis:** Finite element formulation using three-noded triangular (CST) element, Plane stress and Plain strain problems, Shape functions, node numbering and connectivity, Assembly, Boundary conditions, Iso-Parametric formulation of 1-D bar elements, Numerical integration using gauss quadrature formula, computation of stress and strain.	10
5	**Finite Element Formulation from Governing Differential Equation:** Method of Weighted Residuals, Collocation method, Sub domain method, Least Square method and Galerkin's method. Application to one dimensional problems: one-dimensional Heat Transfer. Introduction to variational formulation (Ritz Method).	10
6	**Higher Order Elements:** Lagrange's interpolation formula for one and two independent variables, Convergence of solution, compatibility, element continuity, Static condensation, p and h methods of mesh refinement, Aspect ratio and element shape, Introduction to concept of element mass matrix in dynamic analysis.	8
	Total	**45**

Text Books:

1. Dixit, U. S., “Finite Element Methods for Engineers” Cengage Learning Finite Element Procedure in Engineering Analysis, Bathe K.J., Prentice Hall India.

Reference Books:

1. Seshu, P."Text Book of Finite Element Analysis", Prentice Hall India
2. Reddy J.N., “An Introduction to the Finite Element Method”, Tata McGraw-Hill, New Delhi

Prerequisite:

1. Basic calculus (Differentiation and Integration)
2. Differential Equations (ODEs)
3. Linear Algebra
4. Solid Mechanics

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Computer Integrated Manufacturing System Lab	**Course Code**: MEUP620	**Credit**: 1
Max Marks: 100	**CIE:** 60	**SEE:** 40
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 0L+0T+2P	

S. No.	Contents	Hours
1.	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2.	To perform plain turning operation on CNC lathe using a part program.	1
3.	To perform step turning operation on CNC lathe using a part program.	4
4.	To perform plain turning operation on CNC lathe using turning cycle program.	4
5.	To perform threading operation on CNC lathe using a part program.	4
6.	To perform boring operation on CNC lathe using canned cycle program.	4
7.	To perform profile cutting on CNC Mill using a part program.	4
8.	To perform multiple drilling on CNC Mill using canned cycle program.	4
9.	To model a mechanical component using MasterCAM software and prepare its CNC part program.	4
	Total	**30**

Text Books:

1. Automation, Production Systems, and Computer-Integrated Manufacturing by Mikell P. Groover,5e, 2021, Pearson.

Reference Books:

1. CAD/CAM :Principles and Applications by PN Rao, 3e, 2010, Mc Graw Hill Publication.
2. CAD/CAM:Computer Aided Design and Manufacturing By Mikell P. Groover and E.W. Zimmers, Jr.,1980, Pearson Education.

Prerequisite:

1. Basic knowledge of Manufacturing processes
2. Knowledge of Computer
3. Knowledge of Engineering Materials

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Data Analytics Lab	**Course Code**: MEUP621	**Credit**: 1
Max Marks: 100	**CIE:**60	**SEE:** 40
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 0L+0T+2P	

S. No.	Contents	Hours
1.	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite.	1
2.	To study basics of software packages like MS Excel, SPSS, MINITAB, Power BI, etc.	1
3.	To use basic features of MSECXEL on the given dataset.	4
4.	To develop tables and charts for categorical and numerical data.	4
5.	To perform correlation and regression analysis.	2
6.	To perform binomial and multinomial logistic regression analysis.	4
7.	To use p-value approach for hypothesis testing to test a mean or difference between means of two populations.	4
8.	To perform ANOVA for given dataset.	4
9.	To perform Cluster Analysis for Data Segmentation.	2
10.	To conduct case studies using statistical software and advanced tools of data analytics.	4
	Total	**30**

Text Books:

1. Statistical Analysis with Excel For Dummies Joseph Schmuller, John Wiley & Sons, Inc. 2013
2. MacInnes, J. (2016), “An Introduction to Secondary Data Analysis with IBM SPSS Statistics”, Sage Publishing.

Reference Books:

1. Business Data Analysis Using Excel, David Whigham, OUP 2007
2. Mize Edward, " Data Analytics: The Ultimate Beginner's Guide to Data Analytics", 2019, Venture Ink
3. Introduction to Statistical Quality Control, Douglas C. Montgomery, 2nd Edition, Wiley.

Prerequisite:

1. Basic Mathematics
2. Basic Statistics
3. Basic computer skill

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Machine Design Practice II	**Course Code**: MEUP622	**Credit**: 1
Max Marks: 100	**CIE:** 60	**SEE:** 40
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 0L+0T+2P	

S. No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	Design of components with fatigue loading considerations	3
3	Design of preloaded bolts and bolts subjected to variable stresses.	4
4	Design of helical compression, tension and torsional springs.	4
5	Design of belt and gear drives.	4
6	Selection of anti-friction bearings for different loads and load cycles.	2
7	Design of journal bearing.	2
8	Design of IC Engine components.	4
9	**Design Software Applications:** Part modelling of springs, gears, IC Engine components using Creo and ANSYS software.	6
	Total	**30**

Text Books:

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill.
2. Fundamentals of Machine Component Design, Juvinall R.C, and Marshek K.M, Willey
3. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication

Reference Books:

1. Mechanical Engineering Design, Richard G. Budynas, and J. Keith Nisbett, Tata McGraw Hill
2. Machine Design- an integrated approach Robert L. Norton, Pearson Education.
3. Theory & Problem of Machine Design (Schaum's Outline Series) Hall, Holowenko, Laughlin, Tata McGraw Hill

Prerequisite:

1. Engineering mechanics and mechanics of solids
2. Material science and engineering
3. Machine drawing practice
4. Theory of machines

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Thermal Engineering Lab I	**Course Code**: MEUP623	**Credit**: 1.5
Max Marks:100	**CIE:** 60	**SEE:** 40
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 0L+0T+3P	

S. No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	To study working of four stroke petrol engine and four stroke diesel engine with the help of cut section models.	2
3	To study of working of two stroke petrol and two stroke diesel engine with the help of cut section models.	6
4	To draw valve timing diagram for a single cylinder diesel engine	6
5	To study various types of boilers.	6
6	To study various types of mountings and accessories.	3
7	To study steering system and measurement of steering geometry angles.	3
8	To study braking system with specific reference to types of braking system, master cylinder, brake shoes.	6
9	To study transmission system including clutches, gear box assembly and differential gear box.	6
10	To prepare a comparison chart of different cars on the basis of engine, transmission, braking and safety devises.	3
11	To prepare charts of BS4 and BS6 emission and safety norms.	3
	Total	**45**

Textbooks:

- Ganesan, V. (2012). Internal combustion engines (4th ed.). McGraw Hill Education India.
- Heywood, J. B. (2018). Internal combustion engine fundamentals (2nd ed.). McGraw-Hill Education.
- Mathur, M. L., & Sharma, R. P. (2018). Internal combustion engines (2nd ed.). Dhanpat Rai Publications.

Reference Books:

- Rajput, R. K. (2010). Internal combustion engine. Laxmi Publications.
- Taylor, C. F. (1985). The internal-combustion engine in theory and practice (Vols. 1 & 2, 2nd ed.). MIT Press.

Prerequisite:

1. Basics of Engineering Thermodynamics.
2. Basics of Automobile Engineering.

Name of the Programme: B.Tech. in Mechanical Engineering	**Year**: III	**Semester**: VI
Course Name: Vibration Lab	**Course Code**: MEUP624	**Credit**: 1.5
Max Marks: 100	**CIE:** 60	**SEE:** 40
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 0L+0T+3P	

S. No.	Contents	Hours
1.	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2.	To experimentally analyse pendulum motion by: i) Verifying the relation $T = 2\pi\sqrt{l/g}$ for a simple pendulum ii) Determining the radius of gyration of a compound pendulum.	2
3.	To determine the radius of gyration of a given body using (i) Bifilar suspension. (ii) Trifilar suspension.	6
4.	To determine natural frequency of a spring mass system.	3
5.	To determine natural frequency of an equivalent spring mass system.	3
6.	To determine natural frequency of free torsional vibrations of shaft rotor system for: i. Single rotor system ii. Two rotor system	3
7.	Performing the experiment to find out damping co-efficient in case of free damped torsional vibration.	3
8.	To analyze the forced vibration under harmonic excitation of cantilever beam using electro-dynamic shaker and determination of resonant frequencies.	3
9.	To verify the Dunkerley's rule.	3
10.	To analyze forced vibration of a cantilever beam with a lumped mass at free end.	3
11.	To calculate the natural frequency and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values.	3
12.	To analyze the forced vibration response of a single DOF system at different damping ratio and frequency ratio.	3
13.	To study different vibration measuring instruments.	3
14.	To find out critical speed experimentally and to compare the whirling Speed of a shaft with theoretical values.	3
15.	Experimental measurement of machine vibration amplitude in terms of displacement and velocity using digital vibration meter.	3
	Total	**45**

Text Books:

1. Ambekar, A.G., "Mechanical Vibrations and Noise Engineering", PHI Learning Pvt. Ltd., New Delhi (2012)
2. Grover, G.K., "Mechanical Vibrations", Nem Chand and Bros. (2009)

Reference Books:

1. Rao, S.S, "Mechanical Vibrations", Pearson (2011)
2. Kelly, S.G., "Mechanical Vibrations, Theory and Applications", Cengage Learning (2013)

Prerequisite:

1. Engineering Mechanics
2. Strength of Materials
3. Trigonometry, Matrix Algebra, Differential Equations.