GOVERNMENT OF INDIA
MINISTRY OF
PARLIAMENTARY AFFAIRS

Azadi Ka Amrit Mahotsav

mygov मेरी सरकार

PREAMBLE TO THE CONSTITUTION

PREAMBLE

WE, THE PEOPLE OF INDIA,

having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC **REPUBLIC** and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity;

and to promote among them all

FRATERNITY assuring the dignity of the individual and the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this 26th day of November, 1949, do HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.

I have read the Preamble

[redacted]

Signature

23-01-2022

SRI SIDDHARTHA ACADEMY OF HIGHER EDUCATION

("Deemed to be University u/s 3 of the UGC Act, 1956")
Accredited 'A+' Grade by NAAC
Agalakote, B.H.Road, Tumkur – 572 107.KARNATAKA, INDIA.

No. SSAHE/ACA-S&C/22/UG(BE)/2024 Date: 15/07/2024

N O T I F I C A T I O N

Sub: - Ordinance pertaining to Curriculum of Undergraduate Programme Bachelor of Engineering (4th Year Mechanical Engineering)

Ref: Proceedings of the Academic Council meeting held on 10/07/2024 vide agenda No. SSAHE/AC/XXVIII-12/2024

In exercise of the powers vested under section 6 of 6.05 of MoA / Rules of SSAHE, the Revised Ordinance pertaining to Curriculum of Undergraduate Programme Bachelor of Engineering (4th Year Mechanical Engineering) is notified herewith as per Annexure.

By Order,

REGISTRAR

REGISTRAR
Sri Siddhartha Academy of Higher Education
TUMKUR - 572 107, Karnataka.

To,
Dean / Principal, Sri Siddhartha Institute of Technology,

Copy to
1) Office of the Chancellor, SSAHE, for kind information,
2) PA to Vice-Chancellor / PA to Registrar / Controller of Examinations / Finance Officer, SSAHE
3) All Officers of the Academy Examination Branch / Academic Section
4) Guard File / Office copy.

S.S.A.H.E TUMKUR

DEPARTMENT OF MECHANICAL ENGINEERING

Vision:

To carve technically proficient and competent mechanical engineering graduates capable of addressing the needs of the society and the nation.

Mission:

- To impart quality technical education in core areas of Mechanical Engineering.
- To inculcate Industrial practices for better professional growth.
- To imbibe ethical values, promote entrepreneurship, impart soft skills and teamwork capabilities.
- To ensure self-learning capabilities with an aptitude for research focusing on societal needs

Program Educational Objectives [PEOs]:

PEO– 01 Provide students with sound foundation in mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze problems in the core/allied areas of Mechanical Engineering.

PEO– 02 Provide graduates with competency in the synthesis, modeling and analysis of mechanical/thermal/fluid data, assemblies and systems, research and consultancy in core areas of mechanical engineering, ensuring noticeable social impact.

PEO– 03 Promote awareness about professional ethics, inculcate skills for usage of software tools and prepare graduates of the program for continuous learning capabilities in interdisciplinary/multidisciplinary domains

Program Outcomes [POs]:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals , engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health, safety, cultural, societal and environmental considerations.
4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis, interpretation of data and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, apply appropriate techniques, resources, modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, demonstrate the knowledge and need for sustainable development.
8. **Ethics:** Apply ethical principles, commit to professional ethics, responsibilities and norms of the engineering practice.
9. **Individual and Team work:** Function effectively as an individual, as a member or leader in diverse teams in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend, write effective reports and design documentation, make effective presentations, give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life- Long Learning:** Recognize the need for, have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

PSO1: Automated/Additive Manufacturing--demonstrates knowledge, understanding of manual and automated assembly/manufacturing systems including additive manufacturing systems.

PSO2: Entrepreneurship--recognize the need for and ability to engage in entrepreneurial activities.

Scheme of Teaching and Examination-2022(2020 Scheme)

Outcome-Based Education (OBE) and choice Based Credit System(CBCS)
(Effective from the academic year 2022-23)

VII Semester BE **Academic Year: 2023-24**

VII Semester, BE, Mechanical Engineering (Subjects and Syllabus as per AICTE-Model Curriculum for UG Course in Engg. & Tech :-Jan2018)						**Teaching Hours/Week**				**Examination**			
Sl. No	**Course and course Code**		**Course Title**	**Teaching Dept.**	**Board of Exam**	**L**	**T**	**P**	**C**	**Duration in Hrs**	**CIE**	**SEE**	**TOTAL**
1.	PC	ME7TH1	CONTROL SYSTEMS ENGINEERING	ME	ME	4	0	0	3	3	50	50	100
2.	PC	ME7TH2	HYDRAULICS AND PNEUMATICS	ME	ME	4	0	0	3	3	50	50	100
3.	PE	ME7PE3X	PROFESSIONAL ELECTIVE-III	ME	ME	3	0	0	3	3	50	50	100
4.	PE	ME7PE4X	PROFESSIONAL ELECTIVE-IV	ME	ME	3	0	0	3	3	50	50	100
5.	PE	ME7PE5X	PROFESSIONAL ELECTIVE-V	ME	ME	3	0	0	3	3	50	50	100
6.	PC	ME7LB1	DESIGN LABORATORY	ME	ME	0	0	3	1.5	3	50	50	100
7.	PC	ME7LB2	QUALITY ENGINEERING LAB	ME	ME	0	0	3	1.5	3	50	50	100
8.	PC	ME7PW1	PROJECT WORK PHASE -1	ME	ME	0	0	4	2	-	50	-	50
		Total				**17**	**0**	**10**	**20**	**21**	**400**	**350**	**750**
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination													

PROFESSIONAL ELECTIVE-III
ME7PE31: RAPID PROTOTYPING
ME7PE32: MECHANICAL VIBRATIONS
ME7PE33: POWER PLANT ENGINEERING

PROFESSIONAL ELECTIVE-IV
ME7PE41: OPERATIONS RESEARCH
ME7PE42: TOTAL QUALITY MANAGEMENT
ME7PE43: IC ENGINES

PROFESSIONAL ELECTIVE-V
ME7PE51: ENTERPRISE RESOURCE PLANNING
ME7PE52: QUALITY ENGINEERING
ME7PE53: OPERATIONS MANAGEMENT

Syllabus for the Academic Year - 2023-24

Subject Name: CONTROLSYSTEMS ENGINEERING

Subject Code: ME7TH1 **L-T-P-C: 4-0-0-3**

Sl. No	Course Objective
1	To understand the concepts of control engineering, block diagram reduction technique, stability and compensation techniques.
2	To understand operation and characteristics of control systems
3	To analyze and design control systems using appropriate mathematical tools
4	To apply control techniques to engineering systems

Unit	Description	Hours
I	**INTRODUCTION**: Concepts of automatic controls, open and closed loop systems, concepts of feedback. Requirements of an ideal control system. **TRANSFER FUNCTION** for Mechanical Systems having translational motion. **TYPES OF CONTROLLERS** -Proportional, Integral, Proportional Integral, Proportional Integral Differential controllers (Basic concepts only).	9
II	**BLOCK DIAGRAMS AND SIGNAL FLOW GRAPHS:** Transfer Function definition, block representation of system elements, reduction of block diagrams. Signal flow graphs: Mason's gain formula.	9
III	**TRANSIENT AND STEADY STATE RESPONSE ANALYSIS**: Introduction, First order and second order system response to step, ramp and Impulse inputs, Transient response specifications (No derivation). System stability-Routh's-Hurwitz Criterion	9
IV	**FREQUENCY RESPONSE ANALYSIS USING BODE PLOTS:** Bode attenuation diagrams, Stability Analysis using Bode plots, Simplified Bode Diagrams	9
V	**ROOT LOCUS PLOTS:** Definition of root loci, general rules for constructing root loci, Analysis using root locus plots. SYSTEM COMPENSATION: Series and feedback Compensation, Physical devices for system compensation. (Basic concepts only)	9

Course outcome	Description
CO1	Understand the concepts of control systems, mathematical models of physical systems and compensating networks.
CO2	Apply the concept of transfer functions and Laplace transformation to compute the behavior of different mechanical systems.
CO3	Analyze the response of the system for different inputs and stability by RH criteria.
CO4	Evaluate the stability of the system by frequency domain analysis.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Control system Engineering	U. A. BAKSHI & V. U. BAKSHI	Technical publication, 2010.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Modern Control Engineering,	Katsuhiko Ogata	Pearson Education,2004.
2	Control Systems Principles and Design	M.Gopal	TMH,2000.

Subject Name: HYDRAULICS AND PNEUMATICS

Subject Code: ME7TH2 **L-T-P-C: 4-0-0-3**

Sl. No	Course Objective
1	To understand the basic concepts of hydraulic and pneumatic equipments.
2	To identify the various maintenance methods for hydraulic systems.
3	To understand, design , analyse the hydraulic and pneumatic circuits.

Unit	Description	Hours
I	**Introduction to Hydraulic Power:** Definition of hydraulic system, advantages, limitations, applications, Pascal's law, problems on Pascal's law.	**9**

	Hydraulic Pumps Classification pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps. **Hydraulic Actuators and Motors:** Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors).	
II	**Control Components in Hydraulic Systems:** Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves - compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation. **Hydraulic Circuit Design And Analysis:** Control of Single and Double - Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Hydraulic circuit for force multiplication, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits.	**9**
III	**Maintenance of Hydraulic System:** Hydraulic Oils - Desirable properties, general type of Fluids, Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid -particle Contamination, temperature control (heat exchangers), Pressure switches, trouble shooting. **Introduction to Pneumatic Control:** Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System, fluid conditioners and FRL unit. **Pneumatic Actuators:** Linear cylinder - Types, Conventional type of cylinder- working, End position cushioning, seals, mounting arrangements- Applications. Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application, symbols.	**9**

IV	**Pneumatic Control Valves:** DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling. **Signal Processing Elements:** Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependent controls- types - construction - practical applications, Time dependent controls principle. Construction, practical applications.	**9**
V	**Multi- Cylinder Application:** Coordinated and sequential motion control, Motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves). **Electro- Pneumatic Control:** Principles - signal input and output, pilot assisted solenoid control of directional control valves, Use of relay and contactors. Control circuitry for simple signal cylinder application. **Compressed Air:** Production of compressed air- Compressors Preparation of compressed air-Driers, Filters, Regulators, Lubricators, Distribution of compressed air Piping layout.	**9**

Course outcome	Description
CO1	Understand and explain basics of hydraulic and Pneumatic systems and their applications.
CO2	Apply the concept of maintenance of Hydraulic and Pneumatic control systems.
CO3	Analyze multi-cylinder applications
CO4	Analyze and design of Hydraulic and Pneumatic circuits.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Fluid Power with Applications	Anthony Esposito	Pearson Education Inc, Sixth edition, 2000.
2	Pneumatics and Hydraulics	Andrew Parr	Jaico Publilishing Co, 2015.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Oil Hydraulic systems Principles and Maintenance	S. R. Majurr	Tata Mc Graw Hill Publishing Company Ltd, 2001
2	Industrial Hydraulics	Pippenger, Hicks	McGraw Hill, New York, 2017.

Subject Name: RAPID PROTOTYPING

Subject Code: ME7PE31 **L-T-P-C: 3-0-0-3**

Sl. No	Course Objective
1	To introduce the basics of additive manufacturing/rapid prototyping and its applications in various fields, reverse engineering techniques.
2	To understand about mechanical properties and geometric issues relating to specific rapid prototyping applications.
3	To familiarize students with different processes in rapid prototyping systems.
4	To understand the software requirements of RP.

Unit	Description	Hours
I	**Introduction:** Definition of Prototype, Types of prototypes, Need for the compression in product development, History of **Rapid Prototyping** (RP) systems, Survey of applications, Growth of RP industry and classification of RP systems. **Stereo lithography Systems:** Principle, Process parameter, data files , machine details, process details, build styles, advantages, limitations and Application.	9
II	**Selective Laser Sintering:** Principle of operation, materials, process parameters, data preparation for SLS, advantages, limitations and Applications. **Fused Deposition Modeling:** Principle of operation, detailed process step, materials, Process parameter, advantages, limitations and applications.	9
III	**Solid Ground Curing:** Principle of operation, Machine details, process parameter, advantages , limitations and Applications. **Laminated Object Manufacturing:** Principle of operation, system hardware details, LOM materials, process details and applications. **Concepts Modelers:** Principle, Thermal ink jet printer, Sander's model maker, 3D printer and Laser Engineering Net Shaping.	9

IV	**Rapid Tooling:** *Indirect Rapid tooling*: Silicon rubber tooling, Aluminum filled epoxy tooling (composite tooling), Spray metal tooling, Cast kirksite, 3D keltool. ***Direct Rapid Tooling****:* Direct AIM, Quick cast process, DMLS, Laminate tooling, soft Tooling vs. hard tooling.	9
V	**Software for RP:** STL files, Overview of Solid view, magics, mimics, magic communicator. **Application of Rapid Prototyping and Technology:** Functional models, pattern for investment ,Vacuum casting, medical models, Art models and Engineering analysis models.	9

Course outcome	Description
CO1	Understand Additive manufacturing (AM) ,important technology trends for product development and innovation.
CO2	Exhibit comprehensive knowledge of the broad range of AM processes, devices, capabilities and materials..
CO3	Understand the various softwares, processes, techniques that enable additive manufacturing and fabrication.
CO4	Learn how to make physical objects that fulfill product development/prototyping requirements, using additive manufacturing devices and processes.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Stereo Lithography and other RP & M Technologies	Paul F. Jacobs	SME NY, 1996.
2	Rapid Manufacturing	D.T. Pham and S.S. Dimov	Springer 1st Edition, 2019.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Rapid Prototyping	Terry Wohlers Wohler's Report 2000	Wohler's Association, 2000.
2	Rapid Prototyping Materials	Gurumurthi	IISc Bangalore.2017.
3	Rapid Automated	Lament wood.	Indus press New York , 2019.
4	Rapid Prototyping	Ramesh S.	1ST Edition Ane books Pvt. Ltd 2015

Subject Name: MECHANICAL VIBRATIONS

Subject Code: ME7PE32 **L-T-P-C: 3-0-0-3**

Sl.No	Course Objective
1	Formulate mathematical models in vibrations using Newtons second law or energy principles.
2	Determine a complete solution to the modeled mechanical vibration.
3	Correlate results from the mathematical model to physical characteristics of the actual system
4	Design of a mechanical system using fundamental principles.

Unit	Description	Hours
I	Introduction to mechanical vibrations, a brief overview, SHM, principle of superposition, Beats and Problems. Single DOF system, damped & undamped systems, Free vibration & forced vibrations, Natural frequency of undamped systems and .Lumped parameter model of undamped system, Finding the equations of motions of simple vibrating system, Springs & dampers in combination and problems.	9
II	Damped systems, different types of damping. Problems on the above, Study of response of, systems for under damped, over damped & critically damped cases and Problems.	9
III	Forced vibrations of single DOF, steady state solution and Problems. Reciprocating & rotating unbalance and Problems. Concept of resonance, Whirling of shafts, critical speed and problems.	9
IV	Introduction to vibration measuring instruments, Accelerometers & Vibrometers, Response curves of vibration instruments, Amplitude &phase distortion concepts and problems. Systems with 2 DOF, principal nodes & normal nodes of, Vibration, coordinate coupling, generalized coordinates, Geared systems, discussion with theory, Dynamic Vibration Absorber theory and problems .	9
V	Multi DOF vibrating system, introduction, Method of influence coefficients, Maxwell reciprocal theorem, problems, Orthogonality of principal models, problems, Matrix iteration methods, problems, Holzer's method, problems for translational systems, Geared systems & branched system, Stodala method, translational system, rotational system, Dunkereley's method and problems .	9

Course outcome	Description
CO1	Understand the fundamental principles of vibrations
CO2	Acquire skills to develop mathematical models of physical systems
CO3	Develop an understanding of various methods to measure, reduce and control vibrations in mechanical structures
CO4	Get an exposure to experimental and numerical methods to evaluate the vibration characteristics of systems (single DOF and multi DOF) subjected to free and forced vibrations.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Mechanical Vibrations	Tse, Morse & Hinkle	Prentice Hall of India,2008.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Fundamentals of Mechanical Vibrations	S. Graham Kelly	Mc Graw Hill International edition 2000.
2	Mechanical Vibrations	Austin. H. Church	John Wiley & sons, 1963
3	Theory & practice of Mechanical Vibrations	J.S. Rao & K. Gupta	New Age International Publication 2001.
4	Theory of Vibration with application	William T. Thomson and Maric Dillon Dahleh	Pearson education Inc. 5th Edition, 2003

Subject Name: POWER PLANT ENGINEERING

Subject Code: ME7PE33 **L-T-P-C: 3-0-0-3**

Sl. No	Course Objective
1	To provide knowledge on steam power plants
2	To understand the principles of Gas turbine power plant and diesel power plants.
3	To understand the principles of Hydro-electric power plants
4	To understand the principles of nuclear power plants.

Unit	Description	Hours
I	**Steam Power Plant:** Different types of fuels used for steam generation, Equipment for burning coal in lump form, strokers, different types and oil burners, Advantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverised fuel furnaces, cyclone furnace, coal and ash handing.	**9**
II	High pressure boilers & their classification, A brief account of L. Mont Benson, Velox, Schmidt, Loeffler steam generator **Chimneys:** Natural, forced, induced and balanced draft, Calculations involving height of chimney to produce a given draft. Accessories for the steam generator such as super heaters, desuperheater, control of super heaters, Economizers, Air pre-heaters and re- heaters. Cooling towers and ponds: Different types of towers.	**9**
III	**Diesel engine power plant:** Method of starting diesel engines, Cooling and lubrication system for the diesel engine. Filters, centrifuges, Oil heaters, exhaust system, Layout of a diesel power plant. **Gas turbine power plant**: Advantages and disadvantages of the gas turbine plant, open and closed cycle turbine plants with the accessories	**9**
IV	**Hydro-Electric Plants:** Storage and pondage, flow duration and mass curves, hydrographs, Low, medium and high held plants, pumped storage plants, penstock, water hammer, surge tanks, gates and valves, power house, general layout. A brief description of some of the important hydel installations in India.	**9**
V	**Nuclear power plant**: Principles of release of nuclear energy fusion and fission reactions. Nuclear fuels used in the reactors. Multiplication and thermal utilization factors. Elements of the nuclear reactor, Moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types pressurized water reactor, boiling water reactor sodium graphite reactor, Fast breeder reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, shieldings, Radioactive waste disposal.	**9**

Course Outcomes:

Course outcomes	Description
CO1	Understand the complete process of Power generation in thermal, nuclear and hydroelectric power plants.
CO2	Understand the construction and working of steam generators and their accessories
CO3	Understand the working of various components of diesel power plant.
CO4	Analyze the working of gas turbine power plant and its components.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Power Plant Engineering	P. K. Nag	Tata Mc Graw Hill 2nd edition 2001
2	Power Plant Engineering	R. K. Rajput	Laxmi publication New Delhi,2009.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Power Plant Engineering	Arora and Domkundawar	Dhanpat Rai & Co. (P) Ltd. Sixth Edition, 2012.
2	Power Plant Technology	M.M. El-Wakil	McGraw Hill International,1994.

Subject Name: OPERATIONS RESEARCH

Subject Code: ME7PE41 **L-T-P-C: 3-0-0-3**

Sl.No	Course Objective
1	To equip the students with the knowledge based on OR models for problem solving and decision-making situations in organizations.
2	To develop mathematical model for interactive decision-making situations, where competitors are involved under conditions of conflict.
3	Construct the required activities in an efficient manner so as to complete it on or before a specified time limit and at minimum cost.
4	To make the student analyze the real time problems as operational research models and decide upon optimal solution.

Unit	Description	Hrs
I	**Introduction of OR**, Definition of OR, Scope of OR, Application areas of OR, Phases of OR, Characteristics and limitations of OR, Linear Programing Problems (LPP) by graphical methods. **Simplex Methods**: Standard form of an LPP, Slack & Surplus Variables, Artificial variable or Big M Method	**9**
II	**Transportation Problems:** Formulation of transportation problems, types, initial basic feasible solution using Penalty methods and optimal solution by MODI method, Degeneracy in transportation problems, Applications of Transportation problems, Concept for maximization cases. **Assignment problems**: Formation, Types, solution by Hungarian Method, Unbalanced problems, Comparison b/w Transportation &Assignment problems Application to maximization cases.	**9**
III	**Travelling salesman problems**: Problems faced by travelling salesmen's and routing of machine operations by operators. **Game theory:** Formation of games, types, solution of games with saddle point, Graphical method of solving mixed strategy games, Dominance and Modified Dominance rule for solving mixed strategy games.	**9**
IV	**Sequencing:** Basic assumptions, sequencing 'N' jobs on single machine using priority rules, sequencing using Johnson's rule-'N' jobs on 2 machines, "n; jobs on 3 machines. **Queuing theory:** Queuing systems and their characteristics, Pure birth and Pure death models (Only Equations), empirical queuing models M/M/1 and M/M/C models and their steady state performance analysis.	**9**
V	**PERT and CPM** Techniques: introduction, network construction – rules, Fulkerson's rule numbering the events, AON and AOA diagrams, definitions, different floats. **Critical path method** to find the expected completion time of a project, **PERT methods** for finding expected during of an activity and project, determining the probability of completing a project, predicting a project, predicting the completion time of project; Procedure for crashing of simple projects, Simple projects	**9**

Course outcome	Description
CO1	Identify and develop operational research models from the verbal description of the real system.
CO2	Understand the mathematical tools that are needed to solve optimization problems.

CO3	Use mathematical software to solve the proposed models.
CO4	Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management and Engineering.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Operations Research	Prem Kumar Gupta, D S Hira	S Chand & Company Pvt Ltd, 2016.
2	Operations Research	Kalavathy. S	Vikas Publishing House Pvt Ltd , 2016.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Operations Research Theory & Applications	J.K Sharma	Laxmi Publications (P) Ltd, 2016.
2	Operations Research Theory Methods & Applications	S.D Sharma	Kedar Nath Ram Nath, 2017.

Subject Name: TOTAL QUALITY MANAGEMENT

Subject Code: ME7PE42 **L-T-P-C: 3-0-0-3**

Sl.No	Course Objective
1	To educate students the core concepts of TQM.
2	To educate students to know how one can delight customers through continuous improvement of quality of products and services.
3	To understand the importance of total participation of employees in an organization for improving quality.
4	To educate students to recognize the importance of networking of companies with Govt, Semi-Govt. organizations, Research Institutes and Universities.

Unit	Description	Hrs
I	**Overview of Total Quality Management:** Concept and definition of TQM. Overview of Social system, technical system, house of total quality. History of TQM quality, Consciousness during stone-age, introduction of	**9**

	interchangeable parts and division of labor, scientific Management and Taylorism, Walter Shewart's concept of variation and control system, post world WarII and Japanese resurrection. Contribution of quality Gurus Deming's approach. Juran's Quality Triology, Crosby and quality treatment, Imani's Kaizen. Ishikwa's companywide quality control and Fegenbaum's theory of TQC	
II	**Evolution of Quality Concepts and Method**: Quality concepts. Development of four finesses, Evolution of methodology, evolution of company integration, quality of conformance versus quality of Design from deviations to weaknesses to opportunities. Future fitness, four revolutions in management thinking and four level of practice. **Continuous Improvement:** Improvement as problem solving process: Management by process, WV model of continuous Improvement, process control, process control and process improvement and process versus creativity.	**9**
III	**Reactive Improvement**: Identifying the problem, standard steps and tools, seven steps case study and seven QC tools. Management diagnosis of seven steps reactive improvement. General guidelines for managers diagnosis a QI story. Discussion on case study for diagnosis of the seven steps**.** **Proactive Improvement**: Introduction to proactive improvement, standard steps for Proactive Improvement, semantics, example customer visitation. Applying proactive improvement to Develop New products 3 stages & 9 steps	**9**
IV	**Total Participation**: Teamwork, dual function of work, principles of activating teamwork, creativity in team processes, initiation strategies, CEO involvement, infrastructure for mobilization, goal setting (vision/mission), organization setting, training and education, promotional activities, diffusion of success stories, awards and incentives monitoring and diagnosis, phase-in orientation, alignment phase, evolution of parallel organization.	**9**
V	**Societal Networking**: Networking and societal diffusion, regional and nationwide networking infra-structure for networking, openness with real case, change agent, center for quality management, dynamics of a societal learning system, TQM as learning system, keeping pace with the need for skill, TQM model for skill development, summary. Hoshin management definition, phases, strategic planning, hoshin deployment, conventional business planning, an alternative deployment system, system engineering for alignment, hoshin management V/s management	**9**

Course outcome	Description
CO1	Demonstrate the various aspects which delight the customer.
CO2	Apply the TQM tools & techniques for continuously improving the products.
CO3	Involve employees at all levels for effective implementation of TQM techniques.
CO4	Appreciate mutual learning & develop network with all stake holders.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	A new American TQM- four practical revolutions in management	Shoji Shiba, Alan Graham and David Walden	Productivity Press Portland, Oregon,2012.
2	Quality planning & analysis	J.M Juran and F.M Gryana	TATA McGraw Hill,2008.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Managing for Total Quality	N. Loothetis	Prentice Hall of India, New Delhi,2017.
2	Total Quality Management for Engineers	Mohammed Zairi	Aditya Books Pvt., Ltd., New Delhi,2016.

Subject Name: INTERNAL COMBUSTION ENGINES

Subject Code: ME7PE43 **L-T-P-C: 3-0-0-3**

Sl.No	Course Objective
1	To gain the knowledge on IC engine classification, engine parts and their functions, working of IC engines, combustion phenomenon and engine systems.
2	To know the concept of air standard cycles and to compare the performance of different air standard cycles.
3	To gain the knowledge on characteristics of an ideal fuel and alternative fuels, analysis of combustion products and chemical thermodynamics of fuels.
4	To know about the engine emissions and their control techniques that can be used in the IC engines.

Unit	Description	Hrs
I	**INTERNAL COMBUSTION ENGINES**: Heat Engines, Classification of IC engines, Engine parts and their functions, Four stroke petrol engine, Four stroke diesel engine, valve timing diagram, comparison between petrol and diesel engine, Two stroke system, comparison between two stroke and four stroke engines, Carburetion and carburetor, fuel injection in CI engines, Ignition system in SI engines, Governing (speed control) system, Supercharging, Combustion in SI engines, Combustion in CI engines, Cooling system, Lubrication system.	**9**
II	**GAS POWER CYCLES**: Heat engines, Air standard efficiency, Piston-cylinder arrangement, Carnot cycle, Otto (constant volume) cycle, Diesel (constant pressure) cycle, Dual combustion (mixed or composite) cycle, Comparison of Otto and Diesel cycles, Numericals on gas power cycles.	**9**
III	**FUELS AND COMBUSTION**: Characteristics of an ideal fuel, Classification of fuels; solid fuels, liquid fuels, gaseous fuels, Combustion reaction and combustion analysis, Calorific value of fuels; Bomb calorimeter, Junker's gas calorimeter, Analysis of combustion products, Chemical thermodynamics; stoichiometric coefficients, standard reference state, formation reaction, internal energy, standard enthalpy change, enthalpy of formation, Adiabatic flame temperature, Numericals on analysis of combustion products.	**9**
IV	**ALTERNATE FUELS**: Introduction, Possible alternatives, Solid fuels, Liquid fuels; Alcohol, Methanol, Ethanol, Alcohol for SI engines, Reformulated gasoline for SI engine, Water-Gasoline mixture for SI engine, Alcohol for CI engine, Spark-assisted diesel, Vegetable oil, Biodiesel; production, properties, environmental effects, Gaseous fuels; Hydrogen, Hydrogen engines, Natural gas, CNG, LPG, LPG fuel feed system, Dual fuel operation, Other possible fuels; Biogas, Producer gas, Blast furnace gas, Coke oven gas, Benzol, Acetone, Diethyl Ester.	**9**
V	**ENGINE EMISSIONS AND THEIR CONTROL**: Introduction, Engine emissions, Hydrocarbon emission, Hydrocarbon emission from CI engines, Carbon monoxide emission, Oxides of Nitrogen, Particulates, Other missions; Aldehydes, Sulphur, Lead, Phosphorus, Exhaust Emission Control Methods; Catalytic converters, Particulate traps, Exhaust gas recirculation, Non-exhaust (Evaporative) Emission Control Methods; Evaporation loss control device, Modern evaporative emission control system (vapour recovery system), charcoal canister, Crankcase Blowby Control Method; Intake manifold return PCV system.	**9**

Course outcome	Description
CO1	Define and explain the terminology associated with IC engine, Gas power cycles, Fuel characteristics, Chemical thermodynamics, Engine emissions and their control techniques.
CO2	Understand and explain the essential principles associated with IC engine, Gas power cycles, Combustion thermodynamics, Alternate fuels, Engine emissions and their control techniques.
CO3	Apply the concepts related to gas power cycles, combustion thermodynamics and determine the solutions required.
CO4	Analyze the various IC engines, Gas power cycles, Fuels, Engine emissions control techniques.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Engineering Thermodynamics (Principles and Practices)	Dr. D S Kumar	KATSONS Books, 2014
2	Internal Combustion Engines	V Ganeshan	Mc Graw Hill Education, 2015.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Internal Combustion Engine-Fundamentals	John B Heywood	Mc Graw Hill Education,2014.
2	Internal Combustion Engine	R K Rajput	Laxmi Publications, December 2005

Subject Name: ENTERPRISE RESOURCE PLANNING

Subject Code: ME7PE51 **L-T-P-C: 3-0-0-3**

Sl.No	Course Objectives
1	Evolution of ERP and overview of ERP.
2	ERP related technologies, Data warehousing and Data mining.
3	To focus on a strong emphasis upon practice of theory in Applications and Practical-oriented approach.
4	ERP implementation Life Cycle in industries.

Unit	Description	Hrs
I	**INTRODUCTION TO ERP**: Introduction, Evolution of ERP, What is ERP, Reasons for the growth of the ERP market, The advantages of ERP, Why do ERP Implementations Fail? ENTERPRISE – AN OVERVIEW: Introduction, Integrated Management Information, Business modeling, Integrated Data Model	**9**
II	**ERP AND RELATED TECHNOLOGIES**: Introduction, Business Process Reengineering, Management Information System, Data Warehousing, Data Mining, On-line Analytical Processing, Supply Chain Management.	**9**
III	**BENEFITS OF ERP:** Introduction, Reduction of Lead time, On-time shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Suppler Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Decision – making capability. ERP MODULES: Introduction, Finance, Plant Maintenance, Quality Management, Materials Management.	**9**
IV	**ERP PACKAGES:** Overview of ERP Software Introduction, SAP AG, Baan Company, Oracle Corporation, PeopleSoft, JD Edwards World Solutions Company, System Software Associates, Inc. QAD.	**9**
V	**ERP Implementation Life Cycle**: Pre-Evaluations Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation of Team Training, Testing, Going Live, end user Training, Post Implementation VENDOR, CONSULTANTS AND USERS: Introduction, In-house implementation – Pros and Cons, Vendors, Consultants, End-users.	**9**

Course outcome	Description
CO1	Make use of ERP software and its role in integrating business functions.
CO2	Analyze the strategic options for ERP identification and adoption.
CO3	Design the ERP implementation strategies.
CO4	Create reengineered business processes for successful ERP implementation

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Enterprise Resource Planning	Alexis Leon Tata	McGraw Hill Publishing Company Ltd 1999
2	Enterprise Resource Planning Concept and Practice	Vinod Kumar Garg & Venkatakrishnan	Prentice Hall, India ,2013.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Manufacturing Planning & Controls	Thomas Volloman.	4th Edition, McGraw-Hill Education,1997

Subject Name: OPERATIONS MANAGEMENT

Subject Code: ME7PE52 **L-T-P-C: 3-0-0-3**

Sl.No	Course Objective
1	To get acquainted with the basic aspects of Production Planning & Management aspects
2	To expose the students to various aspects of planning, organizing and controlling operations Management.
3	To understand different operational decisions like Facility Planning, Layout planning
4	To understand modern trends in OM: Total Quality Management.

Unit	Description	Hrs
I	**Operations Management Concepts:** Introduction, Historical development. The trend: Information and Non-manufacturing systems, Operations management, the environment of operations, Factors affecting Domestic and International productivity. **Decision Making:** Operations Decision Making, Decision methodology, use of models, Economic models: Break Even analysis	**9**
II	**Forecasting Demand:** Forecasting objectives and uses, Forecasting variables, Opinion and Judgmental methods: Delphi Technique, Nominal group technique and Market survey. Time series methods, Exponential smoothing, Regression and correlation methods, Application and control of forecasts.	**9**
III	**Aggregate Planning and Master Scheduling**: Introduction, Nature and scope of aggregate Planning, aggregate planning strategies (No Numerical). The master production schedule, Master scheduling process, Introduction to Capacity planning, Infinite loading and finite loading. **Scheduling and Production Controlling Activities:** Objectives and Data requirements. Scheduling strategy and guidelines, Scheduling methodology, Types of schedules. Priority control. **Single Machine Scheduling:** Concept, measures of performance, SPT rule, Weighted SPT rule, EDD rule. **Flow –shop scheduling,** Johnson's rule for 'n' jobs on 2 and 3 machines.	**9**

IV	**Facility Location and Layout of Facility**: Factors affecting location decisions need for, nature of locations decisions, general procedure for making locations decisions, evaluating locations decisions. **Facilities layout** – Need for layout decisions, Types of processing: Product layout, Process Layout, Project type of Layout, Cellular Layout.	**9**
V	**Total Quality Management (TQM):** Definition, Basic approaches, Gurus of Quality, Definition of quality, TQM Framework, Benefits of TQM. **Modern Trends in Manufacturing**: Introduction to: Flexible Manufacturing System (FMS), Quality Management system, KAIZEN, KANBANS, Poke Yoke.	**9**

Course outcome	Description
CO1	Explain the concept and scope of operations management in a business context.
CO2	Recognize the role of Operations management among various business functions and its role to determine Market Demand, Production planning process and scheduling.
CO3	Discuss and analyze the appropriateness and guidelines for Facility location decision and Layout Planning.
CO4	Discuss the current trends in Operations management: Total quality management for improving the efficiency and effectiveness of organizational operations.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Productions & operations management	Adam & Ebert	5th edition PHI, 1998
2	Operations Management	Monks. J.G.	McGraw-Hill International Editions, 1987

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Production and Operations Management	Pannerselvam. R.	PHI learning private ltd,2008
2	Modern Production/Operations Management	Buffa	Wiley Eastern Ltd., 2007.
3	Production and Operations Management	Chary, S.N.	Tata-McGraw Hill., 2018.
4	Operations management	James Dilworth.	PHI, 2016.

Subject Name: QUALITY ENGINEERING

Subject Code: ME7PE53 **L-T-P-C: 3-0-0-3**

Sl.No	Course Objective
1	Understand the basics of Quality Assurance process.
2	Acquire the knowledge of using 7 QC tools in process improvement.
3	Learn about the various types of control charts, their application and interpretation.
4	Analyze the problems using variable and attribute type of data.

Unit	Description	Hrs
I	**Introduction:** Definition of Quality, Dimensions of Quality, Quality Engineering terminology, Brief history of quality methodology, Statistical methods for quality improvement, Quality costs – four categories costs and hidden costs, Brief discussion on sporadic and chronic quality problems, Quality of design and quality of conformance, Quality function deployment, Deming's PDCA cycle, Juran's Quality Trilogy and spiral of quality, Comparison of quality control, quality assurance and Total quality management	**9**
II	**Quality Assurance:** Definition and concept of quality assurance, Departmental assurance activities, Quality Audit concept, Audit Approach, Planning and performing audit activities, Audit reporting, Ingredients of Quality audit program.	**9**
III	**Statistical Process Control:** Introduction to statistical process control – chance and assignable causes of variation. Seven QC tools, Case Studies on application of Seven QC tools. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational subgroups. Analysis of patterns of control charts. Process capability – Basic definition, relation to product tolerance, Cp & Cpk, six-sigma concept of process capability.	**9**
IV	**Control Charts for Variables:** Controls charts for mean and Range(R), statistical basis of the charts, development and use of R charts, interpretation of charts. Control charts for and standard deviation (S), development and use of S chart. Type- I and Type- II errors, control charts for individual measurements.	**9**
V	**Control chart for attributes:** Control charts for defectives **–** development and operation of control chart for constant sample size and variable sample size. Control charts for defects - development and operation of control chart for constant sample size and variable sample size, Choice between variables and attributes control charts. Guidelines for implementing control charts.	**9**

Course outcome	Description
CO1	Apply the fundamental and advanced knowledge of quality engineering.
CO2	Understand Quality assurance process and auditing procedures.
CO3	Demonstrate ability to collect data from a process, plot appropriate control charts and draw inferences.
CO4	Demonstrate ability to analyze attribute quality characteristics charts and draw inferences.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Statistical Quality control & Quality Management.	R.C. Gupta	Khanna Publishers, 9th Edition, 2014.
2	Introduction to statistical Quality Control	D.C. Montgomery	John Wiley and Sons, 6th edition, 2009

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Statistical Quality Control	Grant and Leavenworth	McGraw Hill, 1996.
2	Quality Assurance	Chandrashekar Hiregoudar	Sudha Publications,2013.

Subject Name: DESIGN LABORATORY

Subject Code:ME7LB1 **L-T-P-C: 0-0-3-1.5**

Unit	Description	Hours
	PART -A	
	1. Determination of Natural Frequency, logarithmic decrement, Damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional) 2. Balancing of Rotating masses. 3. Determination of critical speed of a rotating shaft. 4. Determination of Fringe constant of Photo elastic material using. a. Circular disc subjected to diametral compression. b. Pure bending specimen (four-point bending)	

	5. Determination of stress concentration using Photoelasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook.	
	PART-B	
	1. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Proell /Hartnell Governor. 2. Determination of Pressure distribution in Journal bearing. 3. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes. 4. Determination of stresses in curved beam using strain gauge. 5. Experiment on Gyroscope.	

Question paper Pattern:

One Question from part A	- 15 marks (05-write up, 10-calculations & graph)
One Question from part B	- 25 marks (05-write up, 20-calculations & graph)
Viva-Voce	-10 marks

Course outcome	Descriptions
CO1	Identify and select the equipment to conduct the experiments related to design lab.
CO2	Demonstrate the procedure for conduction of experiments.
CO3	Apply the techniques for data collection.
CO4	Analyze the data collected and interpret the results.

Subject Name: QUALITY ENGINEERING LAB

Subject Code:ME7LB2 **L-T-P-C: 0-0-3-1.5**

	Description	Hours
	Part -A 1. To test the Goodness of fit for the given quality characteristics using Uniform distribution 2. To test the Goodness of fit for the given quality characteristics using Binomial distribution 3. To test the Goodness of fit for the given quality characteristics using Normal distribution 4. Construction of control chart for variable quality characteristics 5. Construction of control chart for attribute quality characteristics **Part-B**	

	1. Experiments on Application of 7 QC Tools as applied to Manufacturing and Service Operations. 2. Experiments on correlation and Simple linear regressions 3. Conduction of Design of Experiments – Fractional Factorial approach using catapult. (Demonstration)	

Question paper Pattern:

One Question from part A - 15 marks One Question from part B - 25 marks Viva-Voce -10 marks

Course outcome	Description
CO1	Test the goodness of fit for various probability distributions .
CO2	Construct control charts for variables and attributes and draw appropriate conclusions .
CO3	Data analysis using regression analysis.
CO4	Use 7 QC tools for solving Quality problems

Subject Name: PROJECT WORK PHASE -1

Subject Code: ME7PW1 **L-T-P-C: 0-0-4-2**

1. Maximum of 4 students in a batch.
2. Identification of the problem and literature survey is to be completed.
3. Objectives of the project work has to be finalized in discussion with the guide.
4. Students must make a presentation on proposed project work.

Course outcome	Description
CO1	Identify the problem in the specified area by literature survey.
CO2	Analyze the problem and identify the different methods to solve the problem
CO3	Choose the specified technique to solve the selected problem
CO4	Prepare the project work report .

Scheme of Teaching and Examination-2022(2020 Scheme)

Outcome-Based Education (OBE) and choice Based Credit System(CBCS)

(Effective from the academic year 2022-23)

VIII Semester BE **Academic Year: 2023-24**

VIII Semester, BE, Mechanical Engineering (Subjects and Syllabus as per AICTE-Model Curriculum for UG Course in Engg. & Tech :-Jan2018)						**Teaching Hours/Week**				**Examination**			
Sl. No	**Course and course Code**		**Course Title**	**Teaching Dept.**	**Board of Exam**	**L**	**T**	**P**	**C**	**Duration in Hrs**	**CIE**	**SEE**	**TOTAL**
1.	PE	ME8PE1X	PROFESSIONAL ELECTIVE-VI	ME	ME	3	0	0	3	3	50	50	100
2.	PE	ME8PE2X	PROFESSIONAL ELECTIVE-VII	ME	ME	3	0	0	3	3	50	50	100
3.	PE	ME8TS1	TECHNICAL SEMINAR	ME	ME	0	0	0	2	-	50	-	50
4.	PC	ME8PW2	PROJECT PHASE -2	ME	ME	0	0	16	8	3	50	50	100
		Total				**6**	**0**	**16**	**16**	**9**	**200**	**150**	**350**
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination													

PROFESSIONAL ELECTIVE-VI
ME8PE11: MECHATRONICS & IOT
ME8PE12: LEAN MANUFACTURING
ME8PE13: MATERIALS MANAGEMENT

PROFESSIONAL ELECTIVE-VII
ME8PE21: PROJECT MANAGEMENT
ME8PE22: DESIGN OF EXPERIMENTS
ME8PE23: ADVANCED MANUFACTUING PROCESSES

Subject Name: MECHATRONICS & IOT

Subject Code: ME8PE11 **L-T-P-C: 3-0-0-3**

Sl.No	Course Objective
1	Understand the evolution and development of Mechatronics as a discipline and understand the genesis, impact of IoT applications and architectures in real world
2	Substantiate the need for interdisciplinary study in technology education & Illustrate diverse methods of deploying smart objects and connect them to network.
3	Understand the applications of microprocessors, actuation systems in various systems and to know the functions of each element.
4	Demonstrate the integration philosophy in view of Mechatronics technology and understand the role of IoT in various domains of Industry

UNIT	Description	Hours
I	**Introduction to Mechatronics**: Definition, Multidisciplinary Scenario, Evolution of Mechatronics, Design of Mechatronics system, Objectives, advantages and disadvantages of Mechatronics. **Transducers and Sensors**: Definition and classification of transducers. Definition and classification of sensors. Difference between transducer and sensor, Principle of working and applications of light sensors, proximity sensors and hall effect sensors	9
II	**Microprocessor & Microcontrollers**: Introduction, Evolution of Microprocessor, organization of Microprocessor, basic concepts of programming of Microprocessor, Microcontrollers, classification of Microcontroller, Difference between Microprocessor and Microcontrollers. **Microprocessor Architecture**: Basic elements of control systems, Intel's 8085A Microprocessor architecture and terminology-CPU, memory and address, ALU, Assembler, Data Registers, clock cycle, Instruction cycle, Read cycle ,write cycle, wait state, Buses, Interrupts	9
III	**Electrical Actuation Systems**: - Types of Switching Devices, Mechanical switches, solid-state switches: Diodes, Thyristors and Triacs, Bipolar transistors, MOSFET, Solenoids: Pull and push type solenoid. **Hydraulic Actuation System**: -Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components: Direction Control, Flow control and	9

	pressure control.	
IV	**Introduction to IOT**: What is IOT, Genesis of IoT, IoT Impact, IoT Challenges, IoT Network Architecture and Design, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack.	**9**
V	**Smart Objects:** The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, communication criteria and IoT Access Technologies. **Smart and Connected Cities**: Smart City Use-Case Examples.	**9**

Course outcome	Description
CO1	Illustrate various components of Mechatronics systems, interpret the impact and challenges posed by IoT networks leading to new architectural models
CO2	Assess various control systems used in automation , compare , contrast the deployment of smart objects and the technologies to connect them to network.
CO3	Develop hydraulic, pneumatic , electrical control systems and Illustrate different sensor technologies for sensing real world entities
CO4	Identify the applications of transducers , sensors and IoT .

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Mechatronics-Principles, Concepts and Applications	Nitaigour Prem Chand Mahalik	Tata McGraw Hill, 2003
2	Mechatronics –Electronic Control Systems in Mechanical and Electrical Engineering	W.Bolton	Pearson Education, 2005
3	IoT Fundamentals: Networking Technologies, Protocols and use cases for Internet of Things	David Hanes, Gonzalo Salgueiro Patrick Grossetete, Robert Barton, Jerome Henry	Pearson Education , 2017.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Mechatronics	HMT Ltd.	Tata McGraw-Hill, 2000.
2	The Internet of Things: Key Applications and Protocols	Olivier Hersent, David Boswarthick, Omar Elloumi	Wiley publications, 2018

Subject Name: LEAN MANUFACTURING

Subject Code: ME8PE12 **L-T-P-C: 3-0-0-3**

Sl.No	Course Objective
1	Understand the need for Lean manufacturing (LM) and identify the wastes in an industry.
2	Understand the principles of LM
3	Learn about various primary and secondary tools used in LM
4	Learn about implementation procedure of LM

UNIT	Description	Hours
I	Introduction: SEVEN forms of waste and their description; Historical evolution of lean manufacturing ;Global competition, Customer requirements, Requirements of other stake holders, Meaning of Lean Manufacturing System (LMS), Meaning of Value and waste, Need for LMS, Symptoms of underperforming organizations, Meeting the customer requirement, Elements of LMS.	**9**
II	Primary tools used in LMS: Meaning and Purpose of 5S Work place organization, 5S process – Sort, Set in order, Shine, Standardize, Sustain, Implementing 5S, Meaning and purpose of TPM, Pillars of TPM, Conditions for TPM success, TPM implementation process, Overall Equipment Effectiveness and problems on computation of OEE.	**9**

III	Primary tools used in LMS Contd.: Process Mapping and Value Stream Mapping (VSM) – Need for process maps, advantages, types and its construction, steps in preparing VSM; Concept of work Cell and its design, Line balancing algorithms and problems.	**9**
IV	Secondary tools used in LMS: Cause and effect diagram, Pareto chart, Radar chart, Poke Yoke, Kanban, Automation, SMED, Standardized fixture, DFMA, JIT, Visual workplace, problems on Pareto analysis and computation of number of kanbans.	**9**
V	LMS Rules: Stability, Management, Standardized work, Pull system, Continuous improvement. Lean Implementation: Training, selecting the projects, preparing project charter, project implementation, Project review. Implementing LMS for higher productivity: Operator, process, machinery and equipment, workplace organization, Inventory, LMS Design Process	**9**

Course outcome	**Description**
CO1	Recognize the need for Lean Manufacturing.
CO2	Describe the working principle and application of primary tools used in Lean Manufacturing and Create lean system using Value Stream Map
CO3	Describe the working principle and application of secondary tools used in Lean Manufacturing
CO4	Implement Lean Manufacturing System

Text Books:

Sl No	**Title**	**Author**	**Volume and Year of Edition**
1	Simplified Lean Manufacture	N. Goplakrishnan	PHI, 2010
2	Lean Production Simplified	Pascal Dennis	Productivity Press, 2015

Reference Books:

Sl No	**Title**	**Author**	**Volume and Year of Edition**
1	The Toyota Way	Jeffrey Liker	Tata McGraw-Hill, 2004

Subject Name: MATERIALS MANAGEMENT

Subject Code: ME8PE13 **L-T-P-C: 3-0-0-3**

Sl. No	Course Objective
1	Systems approach to materials management.
2	Forecasting and materials planning.
3	Purchase procedure of raw materials and capital equipments.
4	Supplier relationship management, Inventory analysis and stores management.

UNIT	Description	Hours
I	**Introduction: Materials Management** - Materials Management at Micro-level, Materials Management at Macro-level. Definition of Material Management. Function of Materials Department Interfaces, Benefits of the Integrated Systems Approach.	**9**
II	**Materials Management:** Objectives of Materials Management, Materials Planning, Materials Cycle and Flow Control System. **Purchasing:** Purchasing Principles, Procedures and Practices, Fundamental Objectives of Purchasing, Sources of Supply and Supplier Selection, Purchasing Policy and Procedures.	**9**
III	**Purchasing:** Purchasing in Materials Management System Concept: Vendor-Vendee Relations, Vendor Development, Vendor Rating.	**9**
IV	**Inventory Management and Control Systems:** Definition of Inventories, The Need for Inventory, Types of Inventories, Inventory Control	**9**
V	**MRP:** Advantages and disadvantages. MRP system and MPS system **Materials Management Information System and Computer**: MIS - Management and MM, Computer System for MIS and MM, In-process Materials and Management Control	**9**

Course outcome	Description
CO1	Understand the dynamics of Material Management and system approach to materials managements.
CO2	Understand the organization of Material Management.
CO3	Understanding, analyzing the concepts and principles of management in purchasing.
CO4	Understand the requirements for the registration of firms. Apply the equation to INV control and analyzing the INV system

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Materials Management	K. Datta	PHI Pvt. Ltd, New Delhi, 2001.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Handbook of Materials Management	P. Gopalakrishnan	PHI Pvt. Ltd, New Delhi, 2002

Subject Name: PROJECT MANAGEMENT

Subject Code: ME8PE21 **L-T-P-C: 3-0-0-3**

Sl. No	Course Objective
1	Discuss the importance and difficulties associated with capital investment & generation of project ideas.
2	Describe the key elements of financial estimates of project.
3	List and classify various investment criteria.
4	Describe different forms of project organization and essence of project management.

Unit	Description	Hours
I	**Planning:** Capital Expenditures: Importance and difficulties, Phases of capital Budgeting, Levels of decision making, Facets of Project Analysis, Feasibility Study: A schematic diagram, Objectives of Capital Budgeting.	9

	Generation and Screening of Project Ideas: Generation of Ideas, Monitoring the Environment, Corporate Appraisal, Scouting for project ideas, Preliminary Screening, Project rating index, Sources of positive net present value.	
II	**Financial Estimates and Projections:** cost of projects, means of finance, estimates of sales and productions, cost of production, working capital requirement and its financing, profitability projections, projected cash flow statement, projected balance sheet, multi-year projections.	**9**
III	**Investment Criteria:** Net Present value, benefit cost ratio, internal rate of return, payback period, accounting rate of return, assessment of various methods, investment evaluation in practice. **Project cash flows:** Elements of the cash flow stream, basic principles of cash flow estimation, cash flow illustrations, and cash flows for replacement project.	**9**
IV	**Financing of Projects**: Capital structure, means of financing, internal accruals, equity capital, preference capital, debentures, methods of offering, term loans, working capital advances, miscellaneous sources, raising venture capital, raising capital in international markets, project financing structures, financial closure, credit risk rating. **Venture Capital and Private equity:** VC investors, appraisal process and management, the Indian VC and PE industry, regulation of VC industry in India	**9**
V	**Project Management**: Forms of project organization, project planning, project control, human aspects of project management and Pre-requisites for successful project implementation. **Project Review and Administrative Aspects**: Control of in-progress projects, the post audit, abandonment analysis, administrative aspects of capital budgeting, evaluating the capital budgeting system of an organization.	**9**

Course outcome	Description
CO1	Describe the tools helpful in identifying promising investment opportunities .
CO2	Develop projected cash flow statements and projected balance sheets .
CO3	Analyze investment evaluation methods in terms of theoretical and practical considerations .
CO4	Describe the tools of project management for successful project implementation .

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Project planning analysis, selection, implementation & review	Prasanna Chandra	Tata McGraw Hill, 2010.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Project Management a system approach to planning scheduling & controlling	Harold Kerzner	CBS publishers and Distributors,2002
2	Project Management	Dennis Lock	Taylor & Francis,2013.

Subject Name: DESIGN OF EXPERIMENTS

Subject Code: ME8PE22 **L-T-P-C: 3-0-0-3**

Sl. No	Course Objective
1	Define a full factorial experiment and show how to calculate the main and interaction effects.
2	Demonstrate how to analyze the results of a full factorial design.
3	Explain the role of replication.
4	Describe the threats to statistical validity of a designed experiment.

UNIT	Description	Hours
I	**INTRODUCTION:** Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments.	9
II	**BASIC STATISTICAL CONCEPTS:** Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of	9

	confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size. Illustration through Numerical examples.	
III	**EXPERIMENTAL DESIGN:** Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples. **ANALYSIS AND INTERPRETATION METHODS:** Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples.	**9**
IV	**QUALITY BY EXPERIMENTAL DESIGN:** Quality, Western and Taguchi's quality philosophy, elements of cost, Noise factors causes of variation. Quadratic loss function & variations of quadratic loss function. Robust Design: Steps in Robust Design: Parameter design and Tolerance Design. Reliability Improvement through experiments, Illustration through Numerical examples. **EXPERIMENT DESIGN USING TAGUCHI'S ORTHOGONAL ARRAYS:** Types of Orthogonal Arrays, selection of standard orthogonal arrays, Linear graphs and Interaction assignment, Dummy level Technique, Compound factor method, Modification of linear graphs. Illustration through Numerical examples.	**9**
V	**SIGNAL TO NOISE RATIO:** Evaluation of sensitivity to noise. Signal to Noise ratios for static problems: Smaller-the-better type, Nominal-the –better-type, Larger-the-better type. Signal to Noise ratios for Dynamic problems. Illustration through Numerical examples. **PARAMETER AND TOLERANCE DESIGN:** Parameter and tolerance design concepts, Taguchi's inner and outer arrays, parameter design strategy, tolerance design strategy. Illustration through Numerical examples.	**9**

Course outcome	Description
CO1	Learn about basic statistical concepts, analysis and interpretation methods.
CO2	Learn about experimental design and taguchi orthogonal arrays.
CO3	Learn about parameter and tolerance design concepts.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Design and Analysis of Experiments	Douglas C. Montgomery	Wiley India Pvt. Ltd, 2007.
2	Quality Engineering using Robust Design	Madhav S. Phadke	Prentice Hall ,1989.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Quality by Experimental Design	Thomas B. Barker, Marcel Dekker	Inc ASQC Quality Press.1985.
2	Experiments Planning, analysis, and parameter Design optimization	C.F. Jeff Wu Michael Hamada	John Wiley, 2002.
3	Reliability Improvement by Experiments	W.L. Condra, Marcel Dekker	Inc ASQC Quality Press.1985.

Subject Name: ADVANCED MANUFACTURING PROCESSES

Subject Code: ME8PE23 **L-T-P-C: 3-0-0-3**

Sl.No	Course Objective
1	Acquire a functional understanding of non-traditional manufacturing equipment
2	Understand the terminology used in non-traditional manufacturing industries.
3	To provide knowledge on the classification of non-traditional machining process.
4	Impart knowledge on various energy involved in non-traditional machining process

Unit	Description	Hours

I	**Introduction**: History, Classification, comparison between conventional and non-conventional machining process selection. **Ultrasonic Machining :** Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design: - Effect of parameter: Effect of amplitude and frequency and vibration, Effect of abrasive grain diameter, effect of applied static load, effect of slurry, tool & work material, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM.	**9**
II	**Abrasive Jet Machining :** Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, standoff distance (SOD), nozzle design, shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining: Principal, Equipment, Operation, Application, Advantages and limitations of water Jet machinery **Electrochemical Machining :** Introduction, study of ECM machine, elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics – Material removal rate, Accuracy, surface finish, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement.	**9**
III	**Chemical Machining :** Introduction, elements of process, chemical blanking process: Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process characteristics of CHM: material removal rate, advantages & application of CHM. **Electrical Discharge Machining :** Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear, EDM tool design, choice of machining operation, electrode material selection, under sizing and length of electrode, machining time. Flushing; pressure flushing, suction flushing, side flushing, EDM process characteristics: metal removal rate, accuracy, surface finish, Heat Affected Zone. Machine tool selection, Application.	**9**
IV	**Plasma Arc Machining :** Introduction, equipment, non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Safety precautions, Applications, Advantages and limitations. **Laser Beam Machining :** Introduction, equipment of LBM mechanism of	**9**

	metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations. **Electron Beam Machining:** Principles, equipment, operations, applications, advantages and limitation of EBM.	
V	**Powder Metallurgy:** Introduction, Powder Metallurgy Process, Secondary /Finishing Operations, Characteristics of metal powders / powder testing, Specific characteristics, Advantages of powder metallurgy process, Limitations of powder metallurgy process.	**9**

Course outcome	Description
CO1	Understand the need of Non-Traditional Machining Processes and able to Classify various processes
CO2	Recognize the role of mechanical energy in non-traditional machining processes.
CO3	Apply the knowledge on machining electrically conductive material through electrical energy in non-traditional machining processes.
CO4	Understand the concept of machining the hard material using chemical energy and electrochemical energy.

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Non-Conventional Machining	P. K. Mishra	Narosa Publishing House, New Delhi, 2007.
2	Modern Machining Processes	P. C. Pandey and H.S. Shan	Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2008.

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Advanced Machining Processes	Vijaya Kumar Jain,	Allied Publishers Pvt. Ltd., New Delhi, 2005.
2	Advanced Machining Processes: Nontraditional and Hybrid Machining Processes,	Hassan El-Hofy	McGraw-Hill Professional, New Delhi, 2005

Subject Name: TECHNICAL SEMINAR

Subject Code: ME8TS1 **L-T-P-S-C: 0-0-0-2**

Sl. No	Course Objective
1	To be aware of latest technologies relevant to the topic selected.
2	Improve the communication skills among the students
3	To prepare seminar report and make the presentation.
4	To know the latest developments in mechanical engineering domain.

Descriptions
Guidelines for preparing Technical Seminar **1. Selection of topic/area:** The seminar topic is to be selected by referring various journal papers. **2. Approval to the selected topic:** After selecting the paper, get approval from the concerned faculty in charge. **3. Study of topic:** Students are requested to acquire a thorough knowledge on the subject by referring back papers and reference books (These may be included as references at the end of the paper) on the corresponding area. **4. Seminar:** Final seminar should be presented by the students through PPT.

Course outcome	Description
CO1	Identify the latest technologies relevant to the topic selected through literature survey.
CO2	Plan and organize content in the presentation effectively.

CO3	Communicate the content effectively to the audience and answer satisfactorily to the quires.
CO4	Compile the report of the study

Subject Name: PROJECT WORK PHASE -2

Subject Code: ME8PW2 **L-T-P-C: 0-0-16-8**

Description
Scheme of Evaluation
Project work Phase - II Demonstration: Students have to demonstrate the working model of the project work to their respective guides. **Evaluation Scheme-I (50% percent of CIE):** Continuous evaluation will be done by respective Project Guides based on the Regularity, Technical Knowledge and Competence, Communication Skills, Demonstration skills, Collaborative Learning and Documentation Skills of the students. **Evaluation Scheme II (50% percent of CIE):** The project work of the students are evaluated by the team of faculty members based on the Presentation, Technical Competence, Slides Preparation Team Working Abilities, Questionnaires and overall Performance in the Seminar-1,Seminar-2 on Project work Phase – 2. Students are required to meet their respective project guides on a stipulated day once in a week and update their progress and get signature from the guides.

Course outcome	Description
CO1	Design /fabricate a suitable system to solve the problem identified (project work phase – I) and plan to work as a team.
CO2	Apply and implement the suggestions to the project work to solve the identified problem.
CO3	Analyze the performance of the project and demonstrate the project.
CO4	Compile the project work and presentation.