Bachelor of Technology (Mechanical Engineering), KUK
Credit-Based (2023-24 Onwards)
MODIFIED SCHEME OF STUDIES/EXAMINATIONS (Semester - V)

S. No	Course No./ Code	Subject	L:T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	B23-MEC-301	Heat Transfer	3:1:0	4	4	70	30	--	100	3
2	B23-MEC-303	Production Technology	3:0:0	3	3	70	30	--	100	3
3	B23-MEC-305	Mechatronics	3:0:0	3	3	70	30	--	100	3
4	B23-MEC-307	Design of Machine Elements	2:4:0	6	6	70	30	--	100	3
5	B23-HSM-201	Organizational Behaviour	3:0:0	3	3	70	30	--	100	3
6	B23-MEC-309	Heat Transfer Lab	0:0:2	2	1	--	40	60	100	3
7	B23-MEC-311	Production Technology Lab	0:0:2	2	1	--	40	60	100	3
8	B23-MEC-313	Mechatronics Lab	0:0:2	2	1	--	40	60	100	3
9	B23-MEC-315	Industrial Training-I	2:0:0	2	2	--	100	--	100	--
10	B23-MAC-301	Constitution of India	2:0:0	2	1	--	100	--	100	3
Total				**29**	**25**	**350**	**470**	**180**	**1000**	

B.Tech (5th Sem) Mechanical Engineering							
B23-MEC- 301	**HEAT TRANSFER**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**1**	**-**	**4**	**70**	**30**	**100**	**3**
Purpose	**To build a solid foundation in heat transfer and rigorous treatment of governing equations and solution procedures.**						
Course Outcomes							
CO1	**The students will be able to formulate and analyze engineering problems involving steady and transient heat conduction in various geometries.**						
CO2	**The students will be able to obtain exact solutions for the temperature variation and heat transfer using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer in convection.**						
CO3	**The students will be able to understand the basic laws of radiative heat transfer and evaluate the radiative engineering problems for black and non-black surfaces.**						
CO4	**The students will be able to design and analyze the heat exchangers.**						

UNIT I

Introduction: definition of heat, modes of heat transfer, basic laws of heat transfer, application of heat transfer, simple problems.

Conduction: Derivation of heat balance equation - Steady state one dimensional solution for conduction heat transfer in cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, steady state one dimensional heat conduction with and without internal heat generation for the plane wall and radial systems (cylinder and sphere), conduction through composite wall, critical insulation thickness, variable thermal conductivity; heat transfer through fins of uniform cross-section: governing equation, temperature distribution and heat dissipation rate, effectiveness and efficiency of fins; unsteady heat transfer, lumped system approximation and Biot number, numerical problems.

UNIT II

Convection: Heat convection, concept of thermal and hydrodynamic boundary layers, basic equations, Blasius solution (without derivation), approximate (von-Karman integral equation) solutions to laminar boundary layer equations, forced convection, external and internal flows, natural convective heat transfer, dimensionless parameters for forced and free convection heat transfer, boundary layer analogies (Reynolds and Colburn analogies), estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection. Boiling and condensation heat transfer, pool boiling curve, Nusselt theory of laminar film condensation, numerical problems.

UNIT III

Radiation: mechanism of radiation, electromagnetic spectrum, definitions of radiative properties, concept of black and gray bodies, monochromatic and total emissive power, Planck's distribution law, Stefan Boltzman's law, Wien's displacement law, Kirchoff's law, intensity of radiation, Lambert's cosine law; Heat transfer between black surfaces, radiation shape factor for simple geometries, heat transfer between non-black surfaces: infinite parallel

planes, infinite long concentric cylinders, small gray bodies and small body in large enclosure, electrical network approach for radiative exchange in an enclosure of two or three gray bodies, radiation shields, numerical problems.

UNIT IV

Heat Exchangers: Types of heat exchangers, compact, shell and tube type, plate type heat exchangers, overall heat transfer coefficient, fouling factor, analysis and design of heat exchangers using logarithmic mean temperature difference and NTU method, effectiveness of heat exchangers, multipass heat exchangers, applications of heat exchangers, heat pipe, heat transfer enhancement, numerical problems..

Text books:

1. Fundamentals of Heat and Mass transfer – Frank P. Incropera, David P. Dewitt, T.L. Bergman and A.S. Lavine, Wiley Publications.
2. Heat and Mass Transfer – P.K. Nag, Tata McGraw Hill.
3. Heat and Mass Transfer - D.S Kumar, S.K. Kataria & Sons
4. Heat and Mass Transfer – R. K. Rajput, S. Chand & Sons

Reference books:

1. Heat Transfer: A Practical Approach - Yunus A Cengel, Tata McGraw Hill.
2. Heat Transfer – J.P. Holman, Tata McGraw Hill.
3. A Text book of Heat Transfer - S.P Sukhatme, University press
4. Heat Transfer – Y.V.C. Rao, University Press.
5. Heat Transfer – P.S.Ghoshdastidar, Oxford Press.

Heat Transfer Data books:

1. Heat and Mass Transfer Data Book - C. P. Kothandaraman, New Age International Publishers
2. Heat and Mass Transfer Data Book - Domkundwar, Dhanpat Rai Publications

	B.Tech. 5th Semester Mechanical Engineering						
B23-MEC-303	**PRODUCTION TECHNOLOGY**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**-**	**3**	**70**	**30**	**100**	**3**
Purpose	**To acquaint the knowledge of different types of machine tools, cutting tools used in different operations, work holding devices and CNC machines.**						
Course Outcomes							
CO1	**After completing the course, the students will be able to understand the concepts of metal machining and working operation of various machine tools.**						
CO 2	**The students will be able to understand the characteristics and materials of cutting tools, and measuring methods.**						
CO 3	**The students will be able to analyse types of thread and purpose of using jig fixtures**						
CO 4	**Students will know the advancements of CNC over conventional machining methods and other programing and tools related aspects related to CNC.**						

UNIT-I

Theory of metal machining: Overview of machining technology: types of machining operation, theory of chip formation in metal cutting: orthogonal cutting model, Geometry of Chip formation actual chip formation, Merchant analysis: forces in metal cutting, the Merchant equation,

Machine tools and machining operations: Turning and related operations: cutting conditions, operations related to turning, engine lathe, other lathes and turning machines, boring machines, drilling and related operations: cutting conditions, operations related to drilling, drill presses, Milling: types of milling operations, cutting conditions, milling machines, high speed machining.

UNIT-II

Technology and materials of cutting tools: Tool life, tool wear, Taylor tool life equation, tool materials: high speed steels, cast cobalt alloys, cemented carbides, cermets and coated carbides, ceramics, synthetic diamonds and cubic boron nitrides, tool geometry: single point tool geometry, effect of tool material on tool geometry, multiple-cutting-edge tools, cutting fluids: types of cutting fluids, applications and selection of cutting fluids.

Metrology and inspection: Limits, fits, and tolerances, gauge design, interchangeability, linear, angular, and form measurements (straightness, squareness, flatness, roundness, and cylindricity) by mechanical and optical methods, surface finish measurement by contact and non-contact methods.

UNIT-III

Threads: Standard forms of screw threads, methods of making threads, thread cutting on lathe, thread chasing, thread milling, thread rolling, thread grinding, thread tapping, automatic screw cutting machines, inspection and measurement of threads.

Jigs and fixtures:

Purpose of using jigs and fixtures in machine shop, Differences between a jig and a fixture, Advantages of using jigs and fixtures, Elements of using jigs and fixtures, principles of jigs and fixture design, Location and degrees of freedom, principles of location, locating Devices, Clamping Devices.

Drill bushes and auxiliary devices, Types of jigs, Types of fixtures. Different materials for jigs and fixtures, Economic of using jigs and fixtures.

UNIT-IV

Unconventional Machining processes:
Introduction, Need for unconventional processes, Classification of unconventional machining processes, process selection, Abrasive jet machining (AJM), Water jet machining (WJM), Ultrasonic machining (USM), chemical machining (CHM), Electrochemical machining (CEM), Electric discharge machining (EDM), Wire cut EDM, laser beam machining (LBM), Electron beam machining (EBM); their process parameters, Principle of metal removal , applications, advantages and limitations.

Computer numerical control (CNC) machines: Classification of CNC machines, modes of operation of CNC, Working of Machine Structure, Automatic tool changer (ATC), Automatic pallet changer (APC), CNC axis and motion nomenclature, CNC toolings – tool pre-setting, qualified tool, tool holders and inserts, Axes Identification in CNC turning and Machining centers, CNC part programming: Programming format and Structure of part programme, ISO G and M codes for turning and milling-meaning and applications of important codes.

Text Books:

1. Fundamentals of modern manufacturing: materials processing and systems by Mikell P. Grover, John Wiley and Sons.
2. Materials and processes in manufacturing by J.T. Black and R.A. Kohser, John Wiley and Sons.
3. Production Engineering and Sciences, by P.C. Pandey and C.K. Singh, Standard Publishers Distributors.
4. Advanced Machining Processes by V. K. Jain, Allied Publishers
5. Production Technology by R. K. Jain, Khanna Publishers.
6. Machine Tools by R. Kesavan & B. Vijaya Ramnath, Laxmi Publications.
7. Machining and Machine Tools by A. B. Chattopadhyay, WILEY INDIA.

Reference Books:

1. Principles of Machine Tools by G.C. Sen & A. Bhattacharya, Tata McGraw Hill, New Delhi
2. Manufacturing Engg. & Tech by S. KalpakJian and S.R. Schmid, Pearsons.
3. Modern Machining Processes by P.C. Pandey & H.S. Shan, T.M.H. Company, New Delhi
4. Production Engineering: P.C. Sharma, S. Chand & Sons.
5. Introduction to Jig and Tool Design by Kempster M.H.A, Hodder & Stoughton, England

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech (5th Semester) Mechanical Engineering							
B23-MEC-305	**MECHATRONICS**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose	The purpose of this course is to provide students with an in-depth knowledge of mechatronics systems. The subject will give knowledge of electronics components to students and assist them to acquire inter disciplinary skills.						
Course Outcomes							
CO1	Students will be able to understand Mechatronics systems, measurement system and control system.						
CO2	The students will be able to understand different sensors and transducers as well as able to select the transducers and sensors as per applications.						
CO3	Students will be able to understand various types of actuation systems.						
CO4	Students will be able to describe different types of number systems and gate system used in digital electronics system. The students will be able to understand Robotics systems.						

UNIT-I

Introduction: Definition and evolution level of mechatronics, advantages & disadvantages of mechatronics, features/characteristics of mechatronics, applications of mechatronics, scope of mechatronics in industrial sector, role of various engineering disciplines in mechatronics, component of mechatronics system, examples of mechatronics system, introduction to measurement system, function of instruments and measurement system, application of measurement system, applications of measurement system, measurement system performance,

Control system: introduction, system, control system commonly used control system component, classification of control system, open-loop control system, closed-loop control system, automatic control systems, servo-mechanism, pneumatic control system, hydraulic control system.

UNIT-II

Sensors and transducers: introduction, mechanical detector-transducer element, definition and classification of transducers, electro-mechanical transducer, transducer actuating mechanism, resistance transducers, variable inductance transducer, capacitive transducers, Piezoelectric transducers, hall effect transducers, thermoelectric transducers, photoelectric transducer, introduction to strain gauges, types of strain gauges, strain gauges circuits, load cells and types of load cells, proximity sensors, pneumatic sensors, light sensors, tactile sensors, smart sensors, fiber optic sensors, digital transducers, selection of sensors, rotary variable differential transformer, induction potentiometer, measurement of linear & angular displacement, measurement of linear & angular velocity, measurement of force, measurement

of torque, measurement of shaft power, measurement of vibration, electromagnetic flow meters, measurement of liquid level, temperature measurements, pressure measurement-electric transducers.

UNIT–III

Actuators: Introduction, mechanical actuation systems, gear drive, belt and belt drives, chain and chain drives, bearings & classification of bearings, electrical actuators, switching devices, drive systems-electric motor, types of DC motors, single phase motors, three phase induction motors, hydraulic actuators, pumps, pressure regulator system, compressors, hydraulic valves, linear actuators, rotary actuators, pneumatic actuators systems.

UNIT–IV

Digital electronics principles: Introduction, advantages and disadvantages of digital electronic, digital circuit, number system, digital coding, logic gates, universal gates.

Robotics: Definition and advantages of robotics, law of robotics, robot, advantages & disadvantages of robots, types of industrial robots, robotics system, robot classification, robot end-effectors, types of end effectors, types of sensors, robot control system, robot drives, application of robots.

Text books:

1. A Textbook of Mechatronics-R. K Rajput, S. Chand & Company, Edition 2010
2. Mechatronics, W. Bolton – Pearson Education Asia - 2nd Edition, 2011.

Reference books:

1. Mechatronics, HMT Ltd., McGraw Hill Education, 2017
2. Mechatronics Principles, Concepts and Application-Nitaigour and Premchand, Mahilik – Tata McGraw Hill – 2003
3. Mechatronics: An Introduction-Robert H. Bishop, CRC Press, 2015
4. Mechatronics: Integrated Mechanical Electronic System- Ramachandran, Vijayaraghavan, Balasundaran- Wiley Publication, 2008

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. (5th Semester) Mechanical Engineering							
B23-MEC-307	**DESIGN OF MACHINE ELEMENTS**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
2	**4**	**0**	**6**	**70**	**30**	**100**	**3**
Purpose	To understand the fundamentals for solving engineering problems relating to design of machine components.						
Course Outcomes							
CO1	The students will understand the design procedures and methods, properties of engineering materials and their selection, design against static and fluctuating loads.						
CO2	The students will be able to solve the design problems of different types of joints and the problems related to the design of springs under different loading conditions.						
CO3	The students will be able to solve the design problems of transmission shafts and keys.						
CO4	The students will be able to solve the design problems related to clutches and brakes and will understand the criteria for the selection of bearings from manufacturer's catalogue.						

UNIT-I

Introduction: Basic procedure of the design of machine elements, standards in machine design, selection of preferred sizes, engineering materials, properties and selection, BIS system of designation of steels.

Design against static load: Modes of failure, factor of safety, stress concentration: causes and mitigation.

Design against fluctuating load: Fluctuating stresses, endurance limit, low cycle and high cycle fatigue, notch sensitivity, endurance limit-approximate estimation, reversed stresses-design for finite and infinite life, cumulative damage in fatigue, Soderberg and Goodman lines, Modified Goodman diagrams.

UNIT-II

Screws and Fasteners: Standard thread forms, power screws, stresses in threads, types of screw fasteners, preloaded fasteners in tension, determining the joint stiffness factor, controlling preload. **Riveted and welded joints:** riveted joints for boiler shell according to I. B. R., riveted structural joint, eccentrically loaded riveted joint, types of welded joints, strength of welds under axial load, welds under eccentric loading.

Springs: Types of spring, helical spring terminology, design for helical springs, spring design-trial and error method, design against fluctuating load, surge in springs, design of leaf springs, rubber springs.

UNIT-III

Transmission shafts: Shaft design on strength basis and torsional rigidity basis, ASME code for shaft design, design of hollow shaft on strength basis and torsional rigidity basis, **Keys:** types of keys, design of square and flat keys.

Clutches: Various types of clutches, design of friction clutches-single disc, multi-disc, cone and centrifugal clutches, torque transmitting capacity, friction materials, thermal considerations.

Brakes: Energy equations, block brake with short shoe, block brake with long shoe, internal expanding brake, band brakes, disc brakes, thermal considerations.

UNIT-IV

Rolling contact bearings: Types of rolling contact bearing, selection of bearing-type, static and dynamic load carrying capacity, equivalent bearing load, load-life relationship, selection of bearings from manufacturer's catalogue, selection of taper roller bearing, design for cyclic loads and speeds, bearing failure-causes and analysis.

Sliding contact bearings: Basic modes of lubrication, Raimondi and Boyd method, bearing design-selection of parameters, bearing materials, bearings failure-causes and remedies.

Text Books:

1. Mechanical Engineering Design by Joseph E. Shigley and Charles R. Mischke, Tata McGraw Hill Book Co.
2. Design of Machine Element by V. B. Bhandari, Mc Graw Hill Edu. Pvt. Ltd.
3. Machine Design by R.S. Khurmi and J.K. Gupta, S. Chand.

Reference Books:

1. Machine Component Design by Robert C. Juvinall and Kurt M. Marshek, Wiley India Pvt. Ltd.
2. Machine Design-an integrated approach, Robert L. Norton Worcester Polytechnic Institute Worcester, Massachusetts
3. Mechanical Design of Machine Elements and Machines by Collins and Busby, Wiley India Pvt. Ltd.
4. Machine Design by U.C. Jindal, Pearsons publications.
5. Analysis and Design of Machine elements by V.K. Jadon and Suresh Verma, IK International Publishing House.

Design Data Books:

1. Design Data Book of Engineers, Compiled by Faculty of Mechanical Engineering, PSG College of Technology, Publisher Kalaikathir Achchagam, Coimbataore, 2009.
2. Design Data Handbook for Mechanical Engineers in SI and Metric Units by Mahadevan and Balaveera Reddy.
3. Machine Design Data book by VB Bhandari.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. (5th Semester) Mechanical Engineering							
B23-HSM-201	**ORGANIZATIONAL BEHAVIOUR**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**-**	**3**	**70**	**30**	**100**	**3 Hours**
Course Outcomes							
Purpose	**The objective of this Course is to make students conversant with the basic concepts of organization behaviour for nurturing managerial skills.**						
CO1	**An overview about organizational behavior as a discipline and understanding the concept of individual behavior.**						
CO2	**Understand the concept and importance of personality, emotions and its importance in decision making and effective leadership.**						
CO3	**Enabling the students to know about the importance of effective motivation and its contribution in group dynamics and resolving conflicts.**						
CO4	**Understand how to overcome organizational stress by maintaining proper organizational culture and effective communication.**						

Unit- I

Introduction to organizational behavior: Concept and importance of organizational behavior, role of Managers in OB, challenges and opportunities for OB.

Foundation of individual behavior: Biographical characteristics, concept and types of abilities, concept of values and attitude, types of attitude, attitude and workforce diversity.

Unit- II

Introduction to personality and emotions: Definition and Meaning of Personality, Determinants of Personality, Personality Traits Influencing OB, Nature and Meaning of Emotions, Emotions dimensions, concept of Emotional intelligence.

Perception and individual decision making: meaning of perception, factors influencing perception, rational decision making process, concept of bounded rationality. Leadership-trait approaches, behavioural approaches, situational approaches, and emerging approaches to leadership.

Unit-III

Motivation: Concept and theories of motivation, theories of motivation-Maslow, two factor theory, theory X and Y, ERG Theory, McClelland's theory of needs, goal setting theory, application of theories in organizational scenario, linkage between MBO and goal setting theory.

Foundations of group behaviour and conflict management: Defining and classifying of groups, stages of group development, Informal and formal groups- group dynamics, managing conflict and negotiation, causes of group conflicts, managing intergroup conflict through resolution.

Unit-IV

Introduction to Organizational Communication: Meaning and importance of communication process, importance of effective communication, organizational stress: definition and meaning sources and types of stress, impact of stress on organizations, stress management techniques.

Introduction to Organization Culture: Meaning and nature of organization culture, types of culture, managing cultural diversity, managing change and innovation-change at work, resistance to change, a model for managing organizational change.

Text Books:

1. Colquitt, Jason A., Jeffery A. LePine, and Michael Wesson. Organizational Behavior: Improving Performance and Commitment in the Workplace. 5th ed. New York: McGrawHill Education, 2017.

2. Hitt, Michael A., C. Chet Miller, and Adrienne Colella. Organizational Behavior. 4th ed. Hoboken, NJ: John Wiley, 2015.

3. Robbins, Stephen P., and Timothy Judge. Organizational Behavior. 17th ed. Harlow, UK: Pearson Education, 2017. Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11th edition, 2008.

Reference Books:

1. Schermerhorn, Hunt and Osborn, Organisational behavior, John Wiley.

2. Udai Pareek, Understanding Organisational Behaviour, Oxford Higher Education.

3. Mc Shane & Von Glinov, Organisational Behaviour, Tata Mc Graw Hill.

4. Aswathappa, K., Organisational Behaviour– Text and Problem, Himalaya Publication.

B.Tech (5th Sem) Mechanical Engineering							
B23-MEC-309	**HEAT TRANSFER LAB**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Internal Assessment**	**Practical Exam**	**Total**	**Time (Hrs)**
-	**-**	**2**	**1**	**40**	**60**	**100**	**3**
Purpose	**To provide necessary skills to the students for carrying out experiments on different modes and heat transfer equipments; perform analysis and interpret results of experimentation.**						
Course Outcomes							
	Students will be able to						
CO1	**Conduct experiments, acquire data, analyze and interpret data and draw valid conclusions.**						
CO2	**Measure the thermal conductivity of metal rod, insulating materials and liquids etc.**						
CO3	**Perform steady state and transient heat conduction experiments and estimate the thermal resistance.**						
CO4	**Measure experimentally heat transfer coefficients in free and forced convection.**						
CO5	**Perform heat radiation experiments and estimate the radiation parameters like Stefan Boltzmann constant and emissivity etc.**						
CO6	**Perform experiments on heat exchanger and determine its performance parameters.**						

List of Experiments:

1. To determine the thermal conductivity of a metal rod.
2. To determine the thermal conductivity of an insulating powder.
3. To determine the thermal conductivity of an insulating slab.
4. To determine the thermal conductivity of a liquid using Guard plate method.
5. To determine the thermal resistance of a composite wall.
6. To determine the overall resistance of a lagged pipe.
7. To determine the internal thermal resistance of solid cylinder under transient conditions.
8. To plot the temperature distribution of a pin fin in free-convection.
9. To plot the temperature distribution of a pin fin in forced-convection.
10. To determine the heat transfer coefficient of forced convection from a cylindrical surface.
11. To determine the Stefan-Boltzman constant.
12. To determine the emissivity of a given plate.
13. To determine the effectiveness of a concentric tube heat exchanger in a parallel flow arrangement.
14. To determine the effectiveness of a concentric tube heat exchanger in a counter flow arrangement.
15. To determine the overall heat transfer coefficient, efficiency and effectiveness for a plate type heat exchanger.
16. To demonstrate the super thermal conductivity of heat pipe.

Note:

1. **At least eight experiments from the above list are to be performed in the semester.**

B. Tech. (5th Semester) Mechanical Engineering							
B23-MEC-311	**PRODUCTION TECHNOLOGY LAB**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Internal Assessment**	**Practical Exam**	**Total**	**Time (Hrs)**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3**
Purpose	**To impart practical knowledge of various measuring instruments, machining and welding operations by performing experiments.**						
Course Outcomes							
CO1	**The students will be able to gain practical knowledge of different measuring instruments used in machining operations.**						
CO2	**The students will be able to perform different machining operations for the preparation of a job piece.**						
CO3	**The students will be able to prepare various jobs using TIG/MIG welding.**						
CO4	**The students will be trained for manufacturing the job pieces on CNC lathe and CNC milling.**						

LIST OF EXPERIMENTS:

1. To make a spur gear of given part drawing involving operations namely drilling, boring, reaming, honing, key slotting, gear teeth machining, lapping and gear teeth finishing.
2. Demonstration of formation of cutting parameters of single point cutting tool using bench grinder / tool & cutter grinder
3. Study of linear, angular measuring devices and to measure the linear and angular dimensions using various equipment's.
4. Manufacture and assembly of a unit consisting of 2 to 3 components to have the concept of tolerances and fits (shaft and bush assembly or shaft, key and bush assembly or any suitable assembly)
5. Introduction to various grinding wheels and demonstration on the cylindrical and surface grinder.
6. To prepare a job on a lathe having various operations viz. drilling, boring, taper turning, thread cutting, knurling, etc.
7. To prepare a useful product containing different types of welded joints using simple arc/TIG/MIG welding set.
8. To demonstrate surface milling /slot milling.
9. To cut V Groove/ dovetail / Rectangular groove using a shaper.
10. To cut gear teeth on milling machine using dividing head.
11. . To cut external threads on a lathe and practice thread measurements.
12. To study CNC milling trainer and its components (hardware and software) especially controllers (Fanuc and Siemens) and make a CNC programme using APT language of given drawing for milling job operations namely end cutting, side cutting, contour cutting, face cutting, etc. and 10(2339) run the programme in simulation and actual

mode in Cut Viewer or other software and run the program in actual mode using CNC controllers.

13. To study CNC lathe trainer and its components (hardware and software) especially controllers (Fanuc and Siemens) and make a CNC programme using APT language of given part drawing for machining cylindrical job involving operations namely turning, step turning, taper turning, threading, radius contour cutting, chamfering etc.

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

B.Tech (5th Sem) Mechanical Engineering							
B23-MEC-313	**MECHATRONICS LAB**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Internal Assessment**	**Practical Exam**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3**
Purpose :	**To acquire knowledge of basic electrical, hydraulic & pneumatic systems as well as understanding the concepts of PLC, sensors and transducer.**						
CO1	**Students will be able to perform experiments on hydraulic, pneumatic and electro-pneumatic training system as well as design the circuit.**						
CO2	**Students will be able to interface as well as speed control of motors.**						
CO3	**Students will be able to define concepts of PLC.**						
CO4	**Students will be able to demonstrate working of sensors and transducer.**						
CO5	**Students will be able to conduct exercise on CNC machine.**						

List of experiments:

1. To Study hydraulic System.
2. To study Pneumatic and electro-pneumatic circuits.
3. To develop pneumatic circuit to operate direct single/double acting cylinder
4. To develop hydraulic circuit to operate direct single/double acting cylinder
5. To study the stepper motor interface.
6. To Perform Speed control of DC motor kit.
7. To study PLC and its applications.
8. To study and conduct exercise on CNC lathe
9. To Study various types of Sensors and transducers.
10. To study the Traffic light interface.

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute

	B. Tech. (5th Semester) Mechanical Engineering						
B23-MEC-315	**INDUSTRIAL TRAINING-I**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Internal Assessment**	**End Semester Exam**	**Total**	**Time (Hrs)**
2	**0**	**0**	**2**	**100**	**--**	**100**	**3**
Purpose	**To provide an industrial exposure to the students and enhance their skills and creative capability for conversion of their innovative ideas into physical reality.**						
Course Outcomes							
CO1	**The students could be capable of self-improvement through continuous professional development and life-long learning.**						
CO2	**The students will be aware about the social, cultural, global and environmental responsibility as an engineer.**						
CO3	**The students will be up-to-date with all the latest changes in technological world.**						

The students will be required to undergo on industrial training of 4 to 6 weeks in any industry/institute which will be evaluated after 4th semester.

The candidate has to submit a training report of his/her work/project/assignment completed in the industry during the training period. The evaluation will be made on the basis of submitted training report and viva-voce/presentation.

	B. Tech. (5th Semester) Mechanical Engineering						
B23-MAC-301	**Constitution of India**						
				Examination Schedule (Marks)			
Lecture	**Tutorial**	**Practical**	**Credit**	**End semester exam**	**Internal assessment**	**Total**	**Duration of Exam (Hours)**
2	**-**	**-**	**1**		**100**	**100**	**3**
Purpose	**This course introduces students to the basic Philosophy of Indian Constitution.**						
Course Outcomes: After completion of course the students will be able							
CO1	**To explain the basic structure of Indian Constitution**						
CO 2	**To understand the structure of Indian Union**						
CO 3	**To write down roles and powers of Governor**						
CO 4	**To explain the election process under Indian Constitution.**						

Unit I

The Constitution - Introduction , The History of the Making of the Indian Constitution ,Preamble and the Basic Structure, and its interpretation , Fundamental Rights and Duties , Brief overview of Directive principles of State Policy.

Unit II

Union Government, Structure of the Indian Union, President – Role and Power, Prime Minister and Council of Ministers, Brief overview of Lok Sabha and Rajya Sabha.

Unit III

State Government , Governor – Role and Power, Chief Minister and Council of Ministers, State Secretariat, distributions of powers between state and centre under Indian Constitution.

Unit IV

Local Administration, District Administration, Municipal Corporation, Zila Panchayat.

Election Commission a. Role and Functioning b. Chief Election Commissioner c. State Election Commission

Suggested Learning Resources:

1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008

2 The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)

3 Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition

Suggested Software/Learning Websites:

1. https://www.constitution.org/cons/india/const.html
2. http://www.legislative.gov.in/constitution-of-india
3. https://www.sci.gov.in/constitution
4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-ofindia/

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEC-302	**PRODUCTION AND OPERATION MANAGEMENT**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3**
Purpose	**This course aims to equip students with essential knowledge in Production and Operations Management, focusing on managing production systems, optimizing resources, and controlling materials.**						
Course Outcomes							
CO1	**The course will equip students with knowledge to manage production systems and optimize operations.**						
CO2	**Students will be able to analyse and optimize plant location and layout decisions for efficient manufacturing and service operations.**						
CO3	**Students will be equipped with the skills to manage materials efficiently, including purchasing, inventory control, and material planning.**						
CO4	**Students will be able to get knowledge to implement quality control techniques, measure work efficiency, and ensure consistent product quality through various methods and standards.**						
CO5	**The course will equip students with the skills to manage materials, prioritize supplies, evaluate vendors, and apply inventory control techniques and solve problems related to CPM and PERT for project management techniques.**						

UNIT-I

Introduction: Historical Evolution of Production and Operations Management: Concept of Production System. Classification of Production System, Objectives of Production Management, Distinction between Manufacturing Operations and Service Operations, Objectives of Operations Management. Managing Global Operations, Scope of Production and Operations Management.

Plant location and layout: Introduction and meaning, factors influencing plant location/facility location, general locational factors, specific locational factors for manufacturing organisation, specific locational factors for service organisation, location models, locational economics, plant layout, classification of layout, design of product layout, design of process layout.

UNIT-II

Materials Management: Introduction and Meaning, Scope or Functions of Materials Management, Material Planning and Control, purchasing: Objectives of Purchasing, Parameters of Purchasing, Purchasing Procedure, Selection of Suppliers, Special Purchasing Systems.

Production Planning and Control: Need for Production Planning and Control, Objectives of Production Planning and Control, Phases of Production Planning and Control, Functions of Production Planning and Control, Aggregate Planning, Master Production Schedule (MPS), Material Requirement Planning (MRP).

UNIT-III

Quality Control: Introduction, Fundamental Factors Affecting Quality, Need for Controlling Quality, process selection, Types of Quality Control, Steps in Quality Control, Objectives of Quality Control, Benefits of Quality Control, Seven Tools for Quality Control, Causes of Variation in Quality. Statistical Process Control, Quality Circles, ISO 9000 Series. Work

measurement - its uses and different methods, computation of allowance and allowed time.

UNIT-IV

Project Management: Introduction to Introduction to Project Management, critical Path calculation, float calculation and its importance, PERT and CPM method. basics of queuing theory, Operating Characteristics of queuing, Components of queuing system, Classification of Queuing Models.

Objectives of Stores Management – Requirements for efficient. Management of Stores - safety stock Inventory Control - Different Systems of Inventory Control, Types of Inventories. Costs - Systems of inventory control – ABC, VED and FNSD analyses.

TEXT BOOKS:

1. S.Anil Kumar, N.Suresh "Production and Operations Management", New Age International (P) Limited HPH.
2. Mahadevan. B, "Operations Management", Pearson Education.
3. Production and Operations Management by Paneer Selvam.
4. Production and Operations Management by P Rama Murthy.

REFERENCES:

1. Kanishka Bedi, "Production and Operations Management",2nd Ed. Oxford University Press.
2. Production and Operations Management by S.N.Murthy.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEC-304	**COMPUTER AIDED DESIGN AND MANUFACTURING**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose	**To apply the computer technology in designing and manufacturing.**						
Course Outcomes							
CO1	**Students will be able to understand the fundamentals of CAD and CAD hardware.**						
CO2	**Students will be able to understand and analyze the various transformation operations and perform geometric modelling.**						
CO3	**Students will be able to analyze the mathematical representation of 2D entity and understand the basics of CNC machine and part programming.**						
CO4	**Students will be able to understand the concept of Group Technology, FMS and CAPP.**						

UNIT-I

Fundamentals of CAD: Introduction, Traditional product cycle, CAD/CAM product cycle, rapid prototypic, design for everything, computer aided design, computer aided engineering, customer relationship management, product life cycle management, Supply Chain Management, Advantages and Disadvantages of CAD/CAM System, Future of CAD/ CAM Engineers.

CAD hardware: Introduction, basic structure of computer, input, storage, processing, output, control, microcomputer, minicomputer, mainframes, supercomputer**,** Networking, LAN, MAN, WAN. Network Topologies.

UNIT-II

Geometric transformations: Introduction, 2D transformation, translation, rotation, scaling, homogeneous coordinate relationship, reflection transformation, shear transformation, inverse transformation for translation, rotation, scaling, reflection, shear, composite transformation, examples of composite transformation, geometric transformations in engineering design, 3D Transformation, Numerical problems.

Geometric modeling: Need of geometric modeling, requirements of geometric modeling, wire frame modeling, surface modeling, solid modeling, difference between wireframe, surface and solid modeling, introduction to solid modeling, set theory, representation schemes for solid models, boundary representation, cellular decomposition, feature based modeling.

UNIT-III

Mathematical representation of 2D entity: Introduction, parametric representation, of analytic curves, lines, circle, conic selection, ellipse, parabola, hyperbola, parametric representation of synthetic curve, Hermite cubic spline curve, Bezier curves, B- spline curve, non-uniform rational, B splines, manipulation of curves, Numerical problems.

Computer Numeric Control Machine: Introduction, Historical Background, Basic Components, Steps in NC, Verification of NC Programs, Basics of Motion control and feedback for CNC Machine, CNC part Programming, Part programming methods, Modern machining systems, Automatically programmed tools, DNC, Adoptive control.

UNIT-IV

Group Technology and Cellular Manufacturing: Introduction, Basic GT layouts, Process layouts, Products layouts, Comparison of product and process layouts, Designing process layouts, Relationship diagramming, Service layouts, Designing product layouts, Coding system.

FMS: Introduction, Dedicated manufacturing system, FMS, Cellular manufacturing system, Major elements of FMS, Material handling system, Problem with FMS, ERP, Mixed model assembly line, Cell technology and FMS.

Computer Aided Process Planning: Automated process planning, CAPP, Methods of CAPP, AI.

Text Books:

1. CAD/CAM/CAE - Chougule N. K, Scitech publications (INDIA) PVT. LTD.
2. Computer Integrated Manufacturing – A. Alavudeen and N. Venkateshwaran, Prentice-Hall of India (p) Ltd.

Reference Books:

3. CAD/CAM Theory and Practice, Mastering CAD/CAM - Ibrahim Zeid, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Mathematical Elements for Computer Graphics - NC-Rogers, D.F. and Adams, McGraw Hill, NY, 1989.
5. CAD/CAM/CIM - P. Radhakrishnan, S. Subramanayan and V. Raju, New Age International (P) Ltd., New Delhi.
6. CAD/CAM: Computer Aided Design and Manufacturing - Groover M.P. and Zimmers E. W., Prentice Hall International, New Delhi, 1992.
7. CAD/CAM – Principle Practice and Manufacturing Management - Chris McMahon and Jimmie Browne, Addison Wesley England, Second Edition, 2000.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEC-306	**REFRIGERATION AND AIR CONDITIONING**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs.)**
3	**1**	**0**	**4**	**70**	**30**	**100**	**3**
Purpose	**The objective of this course is to make the students aware of refrigeration, Air-conditioning, various methods of refrigeration. The course will help the students to build the fundamental concepts in order to solve engineering problems and to design HVAC applications.**						
Course Outcomes							
CO1	**Students will be able to understand different refrigeration processes and able to solve the problems of air refrigeration systems.**						
CO2	**Students will identify different refrigerants and their uses and able to solve vapour compression refrigeration and vapour absorption refrigeration problems.**						
CO3	**Students will grab the knowledge of psychometric properties, psychometric chart and evaluate different cooling and heating processes along with humidification and dehumidification.**						
CO4	**Students will be able to design various air-conditioning systems by including the heat gain through various means.**						

UNIT-I

Introduction: Basics of heat pump and refrigerator, Carnot refrigeration and heat pump, units of refrigeration, COP of refrigerator and heat pump, Carnot COP, Ice refrigeration, evaporative refrigeration, refrigeration by expansion of air, refrigeration by throttling of gas, vapour refrigeration system, steam jet refrigeration, thermo- electric cooling, adiabatic demagnetization.

Air refrigeration: Basic principle of operation of air refrigeration system, Bell Coleman air refrigerator, advantages of using air refrigeration in air craft, disadvantage of air refrigeration in comparison to other cold producing methods, simple air refrigeration in air craft, simple evaporative type, necessity of cooling the aircraft. Numerical problems.

UNIT-II

Simple vapour compression refrigeration system: Simple vapour compression refrigeration system, different compression processes (wet, dry and saturated Compression, superheated compression), representation of theoretical and actual cycle on T-S and P-H charts, effects of operating conditions on the performance of the system, advantages of vapour compression system over air refrigeration system. Limitations of vapour compression refrigeration system.

Advanced vapour compression refrigeration system: Methods of improving COP, flash chamber, flash inter cooler, optimum inter stage pressure for two stage refrigeration system, single expansion and multi expansion cases, basic introduction of single load and multi load systems, cascade systems. Numerical problems.

Vapour absorption refrigeration system and special topics: Basic absorption system, COP and maximum COP of the absorption system. Actual NH_3 absorption system, function of various components, Li-Br absorption system, Selection of refrigerant and absorbent pair in vapour absorption system, Electro-Lux refrigerator, comparison of compression and absorption refrigeration system, Nomenclature of refrigerants, desirable properties of refrigerants, cold

storage and Ice Plants.

UNIT-III

Introduction: Difference between refrigeration and Air-conditioning, Psychrometric properties of moist air (wet bulb, dry bulb, dew point temperature, relative and specific humidity, temperature of adiabatic saturation), empirical relation to calculate P_v of moist air.

Psychrometry: Psychrometric chart, construction and use, mixing of two air streams, sensible heating and cooling, latent heating and cooling, humidification and dehumidification, cooling with dehumidification, cooling with adiabatic humidification, heating and humidification, By-pass factor of coil, sensible heat factor, ADP of cooling coil, Air washer. Numerical problems.

UNIT-IV

Air-conditioning Systems: Classification, factors affecting air-conditioning systems, comfort air-conditioning system, winter air-conditioning system, summer air-conditioning system, year round air-conditioning system, unitary air-conditioning system, central air-conditioning system, Room sensible heat factor, Grand sensible heat factor, effective room sensible heat factor.

Cooling Load calculation: Inside design conditions, comfort conditions, components of cooling load, internal heat gains (occupancy, lighting, appliances, product and processes), system heat gain (supply air duct, A.C. fan, return air duct), External heat gain (heat gain through building, solar heat gain through outside walls and roofs), sol-air temperature, solar heat gain through glass windows, heat gain due to ventilation and infiltration. Numerical problems.

Industrial and Commercial Application: Transport air conditioning, evaporative condensers, cooling towers, heat pumps.

Text Books:

1. Refrigeration and Air-conditioning by C.P. Arora, Tata McGraw-Hill
2. Basic Refrigeration and Air-conditioning by Ananthanarayanan , McGraw-Hill

Reference Books:

1. Refrigeration and Air Conditioning by Arora and Domkundwar, Dhanpat Rai.
2. Refrigeration and air-conditioning by R.C.Arora, PHI

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEC-308	**INTERNAL COMBUSTION ENGINES**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose:	**To provide the detailed understanding of internal combustion engine, air compressors and gas turbines based on its performance and emission parameters.**						
Course Outcomes							
CO1	**Enable the students to understand the basic concepts of Internal and External combustion engines and to familiarize with different air standard cycles.**						
CO2	**Equip the students with types of injection systems, carburetor, detonation and C.I. combustion chambers and to understand their applications.**						
CO3	**Students will have the ability to understand the performance, combustion and emission parameters of S.I. and C.I. engines and to understand various lubrication systems.**						
CO4	**Enable the students to understand the basic concepts of reciprocating air compressors and gas turbine along with exhaust gas heat exchanger.**						

UNIT-I

Heat engines: Internal and external combustion engines; Classification of I.C. Engines; Cycle of operations in four strokes and two-stroke IC engines; Wankel engine.

Air standard cycles: Assumptions made in air standard cycles; Otto cycle; Diesel cycle; Dual combustion cycle; Comparison of Otto, diesel and dual combustion cycles; Sterling and Ericsson cycles; Air standard efficiency, Specific work output. Specific weight; Work ratio; Mean effective pressure; Deviation of actual engine cycle from ideal cycle.

UNIT-II

Carburetor and Injection systems: Mixture requirements for various operating conditions in S.I. Engines; Elementary carburetor, Calculation of fuel air ratio; The complete carburetor; Requirements of a diesel injection system; Type of injection system; Petrol injection; Requirements of ignition system; Types of ignition systems, ignition timing; Spark plugs.

Engine parameters and knocking: S.I. engines; Ignition limits; Stages of combustion in S. I. Engines; Ignition lag; Velocity of flame propagation; Detonation; Effects of engine variables on detonation; Theories of detonation; Octane rating of fuels; Pre-ignition; S.I. engine combustion chambers. Stages of combustion in C.I. Engines; Delay period; Variables affecting delay period; Knock in C.I. Engines; Cetane rating; C.I. Engine combustion chambers.

UNIT-III

Lubrication and cooling systems: Functions of a lubricating system, Types of lubrication system; Mist, Wet sump and dry sump systems; Properties of lubricating oil; SAE rating of lubricants; Engine performance and lubrication; Necessity of engine cooling; Disadvantages of overcooling; Cooling systems; Air-cooling, Water-cooling; Radiators.

Heat balance and emission control: Performance parameters; BHP, IHP, Mechanical efficiency; Brake mean effective pressure and indicative mean effective pressure, Torque, Volumetric efficiency; Specific fuel consumption (BSFC, ISFC); Thermal efficiency; Heat balance; Basic engine measurements; Fuel and air consumption, Brake power, Indicated power and friction power, Heat lost to coolant and exhaust gases; Performance curves; Pollutants from

S.I. and C.I. Engines; Methods of emission control, Alternative fuels for I.C. Engines; The current scenario on the pollution front.

UNIT IV

Air compressor: Working of a single stage reciprocating air compressor; Calculation of work input; Volumetric efficiency; Isothermal efficiency; Advantages of multi stage compression; Two stage compressor with inter-cooling; Perfect inter cooling; Optimum intercooler pressure; Rotary air compressors and their applications; Isentropic efficiency.

Gas turbine: Brayton cycle; Components of a gas turbine plant; Open and closed types of gas turbine plants; Optimum pressure ratio; Improvements of the basic gas turbine cycle; Multi stage compression with inter-cooling; Multi stage expansion with reheating between stages; Exhaust gas heat exchanger; Application of gas turbines.

Text books:

1. Internal Combustion Engine by V. Ganeshan Tata Mc-Graw Hill Publications.
2. Internal Combustion Engine by Mathur & Sharma, Dhanpat Rai Publications.
3. Internal Combustion Engine by Ramalingam Sci-tech publications.
4. Internal Combustion Engine Fundamentals by John B. Heywood, Tata Mc-Graw Hill Publications.

Reference Books

1. Heat Power Engineering by Dr. V.P. Vasandhani & Dr. D.S. Kumar
2. Fundamentals of Internal Combustion Engine by H. N. Gupta, PHI publications.

Note: The paper setter will set the paper as per the question paper template provided.

B.Tech (6th Sem) Mechanical Engineering							
B23-MEC-310	**PROJECT-I**						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Practical Exam**	**Total**	**Time (Hrs)**
0	**0**	**4**	**2**	**0**	**100**	**100**	**3**
Purpose	**To implement the engineering principles and theories into innovative practical projects for solving real world problems.**						
Course Outcomes							
CO1	**The students will be able to apply the theoretical knowledge into practical work.**						
CO2	**The students will be able to learn new things related to latest technologies with the help of practical work.**						

The project work could be done for the problem statement of an industry or practical project in the institute. The students may also opt for the analysis based software projects with proper validation. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

Note: The number of students in a group should not exceed four in general.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEC-312	**COMPUTER AIDED DESIGN AND MANUFACTURING LAB**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Internal Assessment**	**Practical Exam**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	40	60	100	3
Purpose:	**To provide practical knowledge on 3D Software like Solid works.**						
Course Outcomes							
CO1	**Students will be able to draw and design 2D models.**						
CO2	**Students will be able to draw and design 3D modelling.**						
CO3	**Students will be able to simulate the product.**						

List of experiments:

1 To study the 2 dimensional drawing, orthographic views, front view, top view and side view.
2
3 To study the wireframe, surface and solid modelling.
4 Working with the tools like Line, Circle, Copy, Rotate, Move and Mirror etc.
5 Working with creating 3D features (Extrude & Revolve).
6 Working with the tools like Hole, Round, and Chamfer etc.
7 Create the part drawing of product 1 using any 3D software.
8 Draw the part drawing of product 2 using any 3D software.
9 Draw the part drawing of product 3 using any 3D software.
10 To Simulate any three part (product) on any 3D software like Solid works.

Note: Product 1, 2 and 3 must be based on theory of CAD/CAM.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEC-314	**REFRIGERATION AND AIR CONDITIONING LAB**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Internal Assessment**	**Practical Exam**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3**
Purpose	**The course aim to train students in the broad field of refrigeration and air-conditioning through studies involving refrigeration cycles, Psychrometric processes, and relevant system design and performance characterization.**						
Course Outcomes							
CO 1	**The students will be able to understand the basics and working principle of water cooler and refrigeration cycle.**						
CO 2	**The students will be able to understand different cycles of operation in air-conditioning practically.**						
CO 3	**The students will understand the humidity measurement and its importance in air-conditioning.**						
CO 4	**The students will know about the various control devices and parts of refrigeration and air-conditioning systems used in actual practice.**						

LIST OF EXPERIMENTS

1. To study and perform experiment on basic vapour compression Refrigeration Cycle.
2. To study and perform experiment on Solar Air-conditioner based on vapour absorption cycle.
3. To find C.O.P. of water cooler.
4. To study and perform experiments on compound compression and multi-load systems.
5. To study and perform experiment on vapour absorption apparatus.
6. Perform the experiment & calculate various performance parameters on a blower apparatus.
7. To find the performance parameter of cooling tower.
8. To study and perform experiments on window air conditioner.
9. To study and perform experiments on duct type air conditioner.
9. To find RH of atmospheric air by using Sling Psychrometer.
11. To study different control devices of a refrigeration system.
12. To find the performance parameters of Ice Plant.
13. To study and perform experiment on Cascade system.

Note: Students have to perform at least eight experiments from the above list.

	B.Tech. (6th Semester) Mechanical Engineering						
B23-MEP-302	**RENEWABLE ENERGY RESOURCES**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**-**	**3**	**70**	**30**	**100**	**3**
Purpose	**This course aims to provide students with a comprehensive understanding of various renewable and non-conventional energy sources. From the principles of renewable energy and its economic impact to detailed studies on solar, wind, biomass, geothermal, ocean thermal, tidal, and wave energy, students will explore a wide array of energy systems. The course also introduces the Internet of Energy (IoE) to highlight the integration of advanced technologies in energy management. By covering these diverse topics, the course prepares students to contribute to sustainable energy solutions and innovations.**						
Course Outcomes							
CO1	**Student will be able to understand renewable energy principles, economic impacts, alternative energy strategies, sustainable development, and global energy availability, with a focus on India. Students will be able to explore non-conventional energy resources and the Internet of Energy (IoE).**						
CO2	**Students will be able to understand solar energy basics and terminology, solar radiation measurement, energy collectors, and storage methods, solar distillation, power plants, heating, cooling, thermal electric conversion, photovoltaics, pumping, furnaces, and greenhouses.**						
CO3	**Students will be able to understand the principles of wind energy conversion, wind turbines, energy conversion systems, data collection, site selection, and efficiency. Explore biomass energy, photosynthesis, biogas plants, urban waste conversion, site selection, energy plantation, and pyrolysis.**						
CO4	**Students will be able to understand about geothermal energy resources and classifications, Ocean Thermal Energy Conversion (OTEC) principles and cycles, tidal power plant components and types, and wave energy principles and conversion devices.**						

UNIT I

Introduction: Principles of renewable energy; Impact of energy consumption on country's economy; Strategies for alternate energies; the intersection of energy and sustainable development and their implications; Energy sources and their global availability, with a special focus on its availability in India; Non-conventional energy resources: solar, wind, tidal, wave, ocean thermal, biomass, geothermal etc.; Internet of Energy (IoE).

UNIT II

Solar Energy: Introduction; Terminology: Solar constant, beam and diffuse solar radiations, declination, solar altitude, zenith angle, solar azimuth angle, slope and surface azimuth angle, incident angle; Solar Radiation measurement: Pyrheliometer, Pyranometer and sunshine recorder; Solar energy collectors: Flat plate collector and concentrating collector,

Solar energy storage: thermal, chemical, thermos-chemical, electromagnetic; Solar distillation; Solar Pond electric power plant; Solar heating and cooling; Solar thermal electric conversion: low, medium and high temperature; Solar photovoltaics; Solar distillation; Solar pumping; Solar furnace; Solar greenhouses**.**

UNIT III

Wind Energy: Introduction; Principle of wind energy conversion: Properties of wind, wind power and power coefficient; Forces and thrust on blades of wind turbines; Wind energy conversion system (WECS): Windmill; Wind energy data collection; Site selection criteria; Wind machines; Efficiency calculation.

Biomass Energy: Introduction; Photosynthesis; Biomass Resources; Biogas plants: Continuous, dome and drum type and variations, Deen-bandhu biogas plant, pragati bio-gas plant; Urban waste to energy conversion; Site selection for biogas plants; Energy plantation: design and management, advantages, plants proposed for energy plantation; Pyrolysis.

UNIT IV

Geothermal energy: Introduction; Classification of geothermal resources: Vapor and liquid dominated systems with P-V diagrams, geopressured resources; HDR.

Ocean Thermal Energy Conversion (OTEC): Principle of working; Lambert's law; Claude and Anderson cycles; Hybrid cycle.

Tidal Power: Principle; Components of Tidal power plants; Types; energy and power estimation.

Wave Energy: Principle; energy and power estimation; Wave energy conversion (WEC) devices.

Text Books:

1. Non-conventional Energy sources, G D Rai, Khanna Publication, Fourth Edition,
2. Energy Technology, S.Rao and Dr. B.B. Parulekar, Khanna Publication. Solar energy, Subhas P Sukhatme,
   Tata McGraw Hill, 2nd Edition,1996.
3. Fundamentals and applications of renewable energy, McGraw Hill 1st edition, Mehmet Kanoglu, Yunus A. Cengel, John M Cimbala.

Reference Books:

1. Principles of Energy conversion, A. W. Culp Jr., McGraw Hill, 1996.
2. Non-Conventional Energy Resources, Shobh Nath Singh, Pearson, 2018.
3. Renewable Energy: Resources, Challenges and Applications, Ahmad El-Kharouf, Hakan Serhad Soyhan, Mansour Al Qubeissi, IntechOpen, 2020.
4. Energy Resources and Systems, Volume 2: Renewable Resources, Tushar K. Ghosh, Mark A. Prelas, 2011.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEP-304	**SMART MATERIALS**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose	**The purpose of this course is to develop the understanding of various aspects of smart materials, smart structures and their applications.**						
Course Outcomes							
CO1	**Students will be able to recognize the key concepts behind classification and fabrication of smart materials and various functions of intelligent materials.**						
CO2	**Students will be able to categorize the various types of smart structure systems, actuators and sensors.**						
CO3	**Students will be able to describe the various types of SMA based hybrid composites and smart battery materials.**						
CO4	**Students will be able to perceive the structure and properties of various types of nanotubes.**						

UNIT-I

Smart materials: key concepts: Introduction to smart materials, definition of smart materials, define smart materials, basic principles behind smart properties, classification of smart materials according to their production technologies and applications in various industries, approaches to fabrication of smart materials, properties of smart materials, nanoscale and microscale structure property relationship, Intelligent materials, primitive functions of intelligent materials, intelligence inherent in materials, intelligent materials in harmony with humanity, intelligent biological materials, biomimetics.

UNIT-II

Smart materials and structural systems: Introduction, actuator materials, sensing technologies, sensing technologies, microsensors, intelligent systems, hybrid smart materials, passive sensory smart structures, reactive actuator based smart structures, active sensing and reactive smart structures, smart skins.

UNIT–III

Shape memory alloys: Phase transition, shape-memory effect, shape memory alloy fiber/metal matrix composites, shape memory alloy fiber/polymer matrix composites, SMA

particulate / aluminum matrix composites.

Smart battery materials: Introduction, electrochemical concepts involved in a battery, types of batteries, lithium ion batteries, layered oxide cathodes, spinel oxide cathodes, olivine oxide cathodes, carbon anodes.

UNIT–IV

Nanoscale intelligent materials and structures: Introduction, nanotube geometric structures, structures of carbon nanotubes, structures of non-carbon nanotubes, designations of nanotubes and nanostructured materials, mechanical and physical properties of nanotubes; elastic properties, electrical conductivity, magnetoresistance, piezo-resistance, electrokinetics of nanotube, piezoelectric properties, electrochemical effects, nanotube power generation, nanotube contact phenomena.

Text books:

1. Smart Materials and Structures - M.V. Gandhi and B.S. Thompson, Chapman and Hall pub.
2. Encyclopedia of Smart Materials - Mel Shwartz Vol.1 and 2, John Wiley & Sons, Inc.
3. Nano engineering of Structural, Functional, and Smart Materials - Mark J. Schulz, Ajit D. Kelkar, and Mannur J. Sundaresan , Taylor and Francis Pub.

Reference books:

1. Micro and smart systems - Ananthasuresh, Wiley India Ltd.
2. Coursera course Smart Materials: Microscale and Macroscale Approaches - Peter the great St. Petersburg Polytechnic University.

Note: The paper setter will set the paper as per the question paper template provided.

	B. Tech. (6th Semester) Mechanical Engineering						
B23-MEP-306	**INDUSTRY 4.0**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**

Purpose	**To impart knowledge of smart manufacturing for industry 4.0 for making student innovative.**
Course Outcomes	
CO 1	**Students will be able to understand the concept of Industry 4.0 for Smart Manufacturing and the use various hardware used in Smart Manufacturing.**
CO 2	**Students will be able to understand need of various communication protocols, hardware and software, IoT Layers and their relative importance.**
CO 3	**Students will be able to understand cloud-computing IoT platform for Smart Manufacturing.**
CO 4	**Students will be able to understand application of hardware, communication protocol, IoT platform, machine learning etc. to implement IoT for smart manufacturing for the need of Industry 4.0.**

UNIT-I

Industry 4.0 Concept, Globalization and emerging issues, The Fourth Revolution, LEAN manufacturing, Smart and connected business perspectives, Smart factories

Automation Programable Logic Controller (PLC) and its Programming software, Communication of different devices with PLC, Sensor, Smart Sensor, HMI design, Cyber Physical System – key components, ISA-95 architecture, CPS-5C architecture, Concept of Digit Twin.

UNIT-II

Communication Protocols – MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT – History, MQTT broker, Message types, Quality of Service (QoS), Application; OPC UA – History, Specification, Client, Server, Programming with – Free and open-source software, Propriety software; Augmented Reality.

UNIT-III

IoT Platform Data Modelling, IoT platforms – Thing, basic functionalities, Abstract definition of Thing, Networks, etc; IoT Gateway, Machine interfaces – Cloud-based Mosquitto brokers, Programming with – Free and open-source software, Propriety software.

UNIT-IV

Machine Learning Foundation Learning algorithms – Supervised, Unsupervised, Self-learning, Feature learning, etc. Models – Artificial Neural Networks, Decision trees, Regression analysis, Genetic algorithms, etc.; Programming with – Free and open-source software, Propriety software.

Text Books:

1. Christoph Jan Bartodziej, "The Concept Industry 4.0 – An Empirical Analysis of Technologies and Application in Production Logistics", Spinger Gabler, 2015.

2. Alasdair Gilchrist, “Industry 4.0 – The Industrial Internet of Thigs”, Springer Link, 2016.
3. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications.
4. Michahelles, “Architecting the Internet of Things”, ISBN 978-3- 642-19156-5 e-ISBN 9783-642-19157-2, Springer.
5. Hakima Chaouchi, “The Internet of Things Connecting Objects to the Web” ISBN: 978-1-84821-140-7, Willy Publications.
6. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications
7. W. Botton, “Programmable Logic Controllers”, Fourth Edition, Elsevier, 2006.

Reference Books:

1. P. Juahs, K. Molnar, “Key Components of the Architecture of Cyber-physical manufacturing systems”, International Scientific Journal “Industry 4.0”, 2017, issue 5, 205207
2. Jen-Ruey Jiang, “An improved cyber-physical systems architecture for Industry 4.0 smart factories”, Advances in Mechanical Engineering, 2018, Vol. 10(6) 1-15.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEP-308	**WELDING TECHNOLOGY**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose	**To expand the student's knowledge base and practical aspects in various areas of welding processes.**						
Course Outcomes							
CO1	**Students will be able to compare welding with other fabrication processes.**						
CO2	**Students will be able to study the working operation of various types of welding and allied processes and will be able to select the right welding processes for any practical application.**						
CO3	**Students will be able to study the different characteristics of welding arc and welding power sources.**						
CO4	**Students will be able to select arc welding power source and process parameters based on particular applications.**						
CO5	**Students will be able to describe working of various gas welding equipment.**						

UNIT-I

Introduction to welding technology: History of metal-working, Common welding base materials, General advantage of welding, General disadvantage of welding, Welding as compared to casting, Welding as compared to riveting, Practical applications of welding.

Welding and allied processes: Submerged Arc Welding, MIG Welding, TIG Welding, Plasma Arc Welding, Gravity Welding, Flux Cored Arc Welding, Firecracker Welding, Auto-Contact Welding, Arc Stud Welding, Atomic Hydrogen Welding, Electroslag Welding, Electrogas Welding, EBW and LBW, solid phase welding, braze welding, thermal cutting, thermal spraying.

UNIT-II

Welding Arc Characteristics: Arc initiation, Type of welding arc, Physics of welding arc, Arc Structure, Arc stability & arc blow, Arc power, Metal transfer, Forces affecting metal transfer, Modes of metal transfer, factors affecting metal transfer

Arc welding process and equipment: General characteristics of heat source, Working

principle of arc welding processes, static characteristics curves, open circuit voltage, current rating and duty cycles, classes of insulation, power factor.

UNIT–III

Different types of AC and DC power sources: Classification of power sources, Arc welding transformers; methods to control welding current in welding transformers, Motor Driven generators, Arc welding rectifiers comparison of power source, factors for selection of power sources.

Special power sources: Universal type, multi-operator type, solid state power source, inverter based multi-process power source units.

UNIT–IV

Gas welding process and equipment: Working principle of gas welding process, gases used, Gas welding flames

Gas welding Setup and equipment: Gas cylinders, Gas supply systems, pressure regulators, welding hose pipe, welding torch; construction and working of different torch types, selection of welding torch tip size, torch lighters, Backfires and Flashbacks, Reverse Flow and Flashback Valves, torch adjustments, Factors affecting the weld; torch angle and torch tip shutting off torch

Text books:

1. Welding Principle and Practices- Edward R. Bohnart, McGraw-Hill Publications.
2. Modern Arc Welding Technology -S.V. Nadkarni, Oxford and IBH Publishing Pvt. Ltd.
3. Modern Welding - Althouse, Goodheart Willcox co. Inc.
4. Welding Principles and Applications by Larry Jeffus, Cengage Learning

Reference books:

1. Performance Welding Handbook - Robert Finch, MBI publishing company.
2. Welding Processes and Technology - O.P. Khanna, Dhanpat rai publications
3. Welding Science and Technology- Ibrahim Khan, New Age International Publishers.
4. Welding Processes and Technology - R.S. Parmar, Khanna Publishers
5. Welding - A.C. Davies, Cambridge University Press.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEP-310	**THEORY OF ELASTICITY AND PLASTICITY**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose:	**To understand the fundamentals of theory of elasticity and plasticity**						
CO1	**Students will be able to demonstrate the application of plane stress and plane strain in a given situation**						
CO2	**Students will be able to understand the two-dimensional problems in polar coordinate system**						
CO3	**Students will be able to apply stress-strain relations for linearly elastic solids, and Torsion.**						
CO4	**Students will be able to demonstrate the ability to analyse the structure using plasticity.**						

UNIT-I

Introduction: Elasticity – notation for forces and stresses – components of stresses – components of strain – stress strain relationship – Generalized Hooke's law.

Plane stress and plane strain analysis – plane stress – plane strain – differential equations of equilibrium – boundary conditions – compatibility equations – stress function – boundary condition.

UNIT-II

Two dimensional problems in rectangular coordinates – solution by polynomials – Saint Venant's principle – determination of displacements – bending of simple beams – application of Fourier series or two-dimensional problems – gravity loading. Two dimensional problems in polar coordinates – stress distribution symmetrical about an axis – pure bending of curved bars – strain components in polar coordinates – displacements for symmetrical stress distributions – simple symmetric and symmetric problems – general solution of two – dimensional problem in polar coordinates – application of general solution in polar coordinates.

UNIT-III

Torsion of Prismatic Bars: torsion of prismatic – bars with elliptical cross sections – other elementary solution – membrane analogy – torsion of rectangular bars – solution of torsion problems by energy method – use of soap films in solving torsion problems – hydro dynamical analogies – torsion of shafts, tubes, bars etc. Bending of Prismatic Bars: Stress function – bending of cantilever – circular cross section – elliptical cross section – rectangular cross section – bending problems by soap film method – displacements.

UNIT-IV

Plasticity: Physical Assumptions – Yield criteria – Failure theories – Applications of thick cylinder – Plastic stress strain relationship. Elasto – plastic problems in bending and torsion.

Reference and Text Books:

1. Theory of Elasticity (third edition) by Timeshanko, McGrawhill Publications, 2010.
2. Theory of Plasticity (third edition) by J.Chakarbarthy, McGrawhill Publications, 2006.
3. Theory of Elasticity by Y.C.Fung.
4. Theory of Elasticity by Gurucharan Singh
5. Theory of Elasticity by Sadhu Singh, Khanna Publishers, New Delhi

Note: The paper setter will set the paper as per the question paper templates provided.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEP-312	**INDUSTRIAL ROBOTICS**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3**
Purpose	This course aims to equip students with the knowledge of automation and robotics, focusing on industrial applications. It covers key concepts, technologies, and components, enabling students to design, control, and optimize automated systems and robots for efficient industrial operations.						
Course Outcomes							
CO1	Students will be able to understand the automation technologies, fluid power systems, and their applications, along with the design, advantages, and challenges associated with pneumatics and hydraulics in industrial settings.						
CO2	The course will equip students with knowledge of robotics, including its history, components, classifications, safety considerations, and the integration of robotics with machine vision and maintenance practices.						
CO3	The course will provide students with an understanding of robotics sensors and end effectors, including types of sensors, their functions, and the design and selection of grippers and tools used in robotic manipulation.						
CO4	The course will provide students with knowledge of control valves and robot programming, covering valve classifications, types of control valves, robot programming techniques, and the applications of robotics in various industries.						

Unit -I

Introduction: Automation, Mechanization vs Automation Advantages of Automation Goals of Automation Social Issues of Automation Low-Cost Automation Types of Automation Current Emphasis in Automation, Issues for Automation in Factory Operations Strategies for Automation.

Basic Pneumatic and Hydraulic Systems: Introduction to Fluid Power, Basic Elements of Fluid Power System Advantages and Disadvantages of Fluid Power Applications of Fluid Power Pneumatics vs. Hydraulics. Basic Pneumatic System, Basic Hydraulic System, Hydraulic System Design and Fluids Used in Hydraulics.

Unit -II

Robotics: Introduction, History of Robots, Definition of a Robot, Industrial Robot, Laws of Robotics, Motivating Factors Advantages and Disadvantages of Robots, Characteristics of an Industrial Robot, Components of an Industrial Robot, Comparison of the Human and Robot Manipulator, Robot Wrist and End of Arm Tools.

Robot Terminology: Robotic Joints, Classification of Robots Robot, Classification on the Basis of Co-Ordinate Systems, Robot Classification on the Basis of Power Source Robot, Classification on the Basis of Method of Control Robot, Classification on the Basis of Programming Method, Robot Selection, Robot Work cell, Machine Vision Robotics and Machine Vision Robotic Accidents Robotics and Safety Robots Maintenance.

UNIT-III

Robotics Sensors: Introduction, Types of Sensors in Robots, Exteroceptors or External Sensors Tactile Sensors, Proximity Sensors (Position Sensors), Range Sensors, Machine Vision Sensors, Velocity Sensors, Proprioceptors or Internal Sensors Robot with Sensors.

Robot end effectors: Introduction, End Effector, Classification of End Effectors, Grippers, Selection of Gripper, Gripping Mechanisms, Tools Types of Tools Characteristics of End-of-

Arm Tooling, Elements of End-of-Arm Tooling, Types of Grippers, Finger Grippers, Mechanical Grippers, Vacuum/Suction Grippers, Magnetic Grippers.

UNIT-IV

Control Valves: Introduction, Classification of Valves: Direction Control Valves Symbol and Designation of Direction Control (DC) Valve, Classification of DC Valves, Classification of DC Valves on the Basis of Methods of Valve Actuation Symbols for Valve Actuators, Check Valve, Pressure Control Valves, Pressure Relief Valve, Pressure Reducing Valve, Sequence Valve, Counterbalance Valve, Flow Control Valves, Non-Return Flow Control Valve.

Robot Programming and Applications: Introduction, Robot Programming, Robot Programming Techniques, Online Programming, Lead-Through Programming, Walk-Through Programming or Teaching Offline, Programming Task Level Programming Motion, Programming Overview of Robot Programming, Languages Requirements for a Standard Robot Language, Robot Languages, Types of Robot Languages. Applications of robotics.

Text books:

1. Robot Analysis and Control- Asada, H., and J. J. Slotine, Wiley.
2. CAD/CAM: Computer Aided Design and Manufacturing- Groover M.P. and Zimmers E. W., Prentice Hall International, New Delhi.

Reference Books:

1. Robotics and Control-R. K. Mittal, I. J. Nagrath, McGraw Hill.
2. Fundamental of Robotics Analysis and Control-Robert J Schilling, Pearson
3. Industrial Automation and Robotics-J K Arora, Laxmi Publications.

Note: The paper setter will set the paper as per the question paper templates provided.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEP-314	**OPTIMIZATION TECHNIQUES**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose	**The purpose of this course is to develop the understanding of various aspects of linear, Non Linear and intelligent optimization techniques.**						
Course Outcomes							
CO1	**Students will be able to Understand the principles of optimization.**						
CO2	**Students will be able to solve problems from Linear optimization.**						
CO3	**Students will be able to solve problems of constrained optimization.**						
CO4	**Students will be able to solve problems of Unconstrained optimization.**						
CO5	**Students will be able to apply intelligent optimization techniques.**						

Unit I

Introduction to Optimization: Engineering application of Optimization – Statement of an Optimization problem – Optimal Problem formulation – Classification of Optimization problem. Optimum design concepts: Definition of Global and Local optima – Optimality criteria – Review of basic calculus concepts – Global optimality

Linear programming methods for optimum design: Review of Linear programming methods for optimum design – Post optimality analysis – Application of LPP models in design and manufacturing.

Unit II

Optimization algorithms for solving unconstrained optimization problems – Gradient based method: Cauchy's steepest descent method, Newton's method, Conjugate gradient method.

Unit III

Optimization algorithms for solving constrained optimization problems – direct methods

– penalty function methods – steepest descent method – Engineering applications of constrained and unconstrained algorithms.

Unit IV

Modern methods of Optimization: Genetic Algorithms – Simulated Annealing – Ant colony optimization – Tabu search – Neural-Network based Optimization – Fuzzy optimization techniques – Applications. Use of Matlab to solve optimization problems.

Text Books

1. Rao S. S. – 'Engineering Optimization, Theory and Practice' – New Age International Publishers – 2012 – 4th Edition.
2. Parkinson, A.R., Balling, R., and J.D. Hedengren, Optimization Methods for Engineering Design, Second Edition, Brigham Young University, 2018.

Resources

1. Deb K. – 'Optimization for Engineering Design Algorithms and Examples' – PHI – 2000
2. Arora J. – 'Introduction to Optimization Design' – Elsevier Academic Press, New Delhi – 2004
3. Saravanan R. – 'Manufacturing Optimization through Intelligent Techniques' – Taylor & Francis (CRC Press) – 2006
4. Hardley G. -'Linear Programming' – Narosa Book Distributors Private Ltd. – 2002

B. Tech (6th Semester) Mechanical Engineering							
B23-MEP-316	**DESIGN OF TRANSMISSION SYSTEMS**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose	**To understand the components of transmission systems and make the students capable of design the transmission system and its various elements.**						
Course Outcomes							
CO 1	**Students will be able to design and select belt drives, pulleys and the chain drives from manufacturer's catalogue.**						
CO2	**Students will be able to apply the Lewi's and Buckingham's equations for the design of spur and helical gears.**						
CO3	**Students will be able to design bevel gears and worm gear based on strength rating, wear rating.**						
CO4	**Students will be able to design gear boxes, couplings and discuss their applications.**						

Unit-I

Design of Flexible Elements: Design of Flat belts and pulleys, Selection of V belts and pulleys, Selection of hoisting wire ropes and pulleys, Design of Transmission chains and Sprockets

UNIT-II

Gear drives: Classification of gears, selection of type of gears, law of gearing, standard systems of gear tooth, interference and undercutting, backlash.

Design of spur gears: geometry and nomenclature, force analysis, material selection, beam strength of gear tooth, effective load on gear tooth, module estimation based on beam strength, wear strength of gear tooth, module estimation based on wear strength, spur gear design procedure.

Design of helical gears: geometry and nomenclature, force analysis, beam strength of helical gears, effective load on gear tooth, wear strength of helical gears, design procedure.

UNIT-III

Design of bevel, worm and cross helical gears: Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

UNIT-IV

Design of speed reducers (gear boxes): Geometric progression, standard step ratio, ray diagram, kinematics layout, design of sliding mesh gear box, design of multi speed gear box for machine tool applications, constant mesh gear box, speed reducer unit, variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

Design of couplings: Design of muff coupling, clamp coupling, rigid flange couplings and

bushed-pin flexible couplings.

Text Books:

1. Mechanical Engineering Design, Joseph E. Shigley and Charles R. Mischke, Tata McGraw Hill Book Co.
2. Automotive Power Transmission Systems, Yi Zhang and Chris Mi, Wiley Publications.
3. Design of Machine Element, V. B. Bhandari, Mc Graw Hill Edu. Pvt. Ltd.
4. Machine Design, R.S. Khurmi and J.K. Gupta, S. Chand.
5. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.

Reference Books:

1. Machine Component Design, Robert C. Juvinall and Kurt M. Marshek, Wiley India Pvt. Ltd.
2. Mechanical Design of Machine Elements and Machines, Collins and Busby, Wiley India Pvt. Ltd.
3. Machine Design, U.C. Jindal, Pearsons publications.
4. Design of Transmission Systems, E.V.V. Ramamurthy and S. Ramachandaran, Air Walk Publications.
5. Handbook of Gear Design and Manufacture, S. P. Radzevich, CRC Press, T&F.

Design Data Books:

1. Design Data Book of Engineers, Compiled by Faculty of Mechanical Engineering, PSG College of Technology, Publisher Kalaikathir Achchagam, Coimbataore, 2009.
2. Design Data Handbook for Mechanical Engineers in SI and Metric Units, 4^{th} Ed, Mahadevan and Balaveera Reddy.
3. Machine design data book, V.B. Bhandari, Mc Graw Hill Edu. Pvt. Ltd.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEP -318	**NON-CONVENTIONAL MACHINING**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose:	**This course provides the knowledge about the advanced technologies and different processes of non-conventional machining.**						
Course Outcomes							
CO1	**To impart the basic knowledge of various non-conventional machining processes, hybrid non-traditional processes and nano polishing process parameters and metal removal mechanism of Ultra-Sonic machining process.**						
CO2	**To acquaint the student with deep knowhow about the Electrochemical and Electro Discharge machining processes.**						
CO3	**To acquaint the students to classify the various kind of Jet machining processes, process parameters and metal removal mechanism, limitations and applications associated with these processes.**						
CO4	**To learn about nano finishing and hybrid non-traditional processes.**						

UNIT-I

Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes

Ultrasonic Machining: Element of process, design of cutting tool, metal removal mechanism, effect of parameters, economic consideration, limitation and applications, surface finish.

UNIT-II

Chemical and Electro Chemical Energy Based Processes

Principles, equipment's, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.

UNIT-III

Jet Machining: Principal and metal removal mechanism of abrasive and water jet machining, process variables, advantage, limitation and application.

Thermo-electric energy-based processes: Plasma arc machining, Electron beam machining, Laser beam machining, their principal of metal removal mechanism, process parameter, advantage and limitations.

UNIT-IV

Nano finishing processes: Principles, equipment's, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magneto rheological finishing, Magneto rheological abrasive flow finishing.

Hybrid non-traditional machining processes: Introduction - Various hybrid non-traditional machining processes, their working principles, equipment's, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non- traditional

machining processes.

Text Books:

1. Adithan. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458
   2. Anand Pandey, "Modern Machining Processes", Ane Books Pvt. Ltd., New Delhi, India, 2019.

Reference Books:

1. Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.
2. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN- 13: 978-3319259208
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes: Fundamentals and Applications", Springer International Publishing., Switzerland, 2017, ISBN:978-3- 319-52008-7

Note: The paper setter will set the paper as per the question paper template provided

	B.Tech. (6th Semester) Mechanical Engineering						
B23-MEP-320	**POWER PLANT ENGINEERING**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**-**	**3**	**70**	**30**	**100**	**3**
Purpose	**To understand modern aspects of power generation, different power plants, their combinations, operation and components, energy demand and supply and power plant economics.**						
Course Outcomes							
CO1	**Students will be able to analyze the economic aspects of power generation, locations, and factors affecting the economics of power generation and distribution. Students will be able to evaluate different types of power plants, considering recent developments, planning, site selection, and performance characteristics.**						
CO2	**Students will be able to understand and analyze various steam cycles and their efficiency, including the Rankine cycle and its modifications. Students will be able to evaluate coal handling systems and processes in power plants, from unloading to ash disposal.**						
CO3	**Students will be able to understand the principles and technologies involved in solar power generation, including various solar collectors, thermal and electric conversion systems, and hybrid solar-hydro power plants. Students will be able to analyze diesel engine and gas turbine power plants, focusing on their components, performance characteristics, supercharging, and material selection.**						
CO4	**Students will be able to understand the principles of nuclear power generation, including nuclear fission and fusion, reactor types, and nuclear waste disposal. Students will be able analyze various power plant combinations, such as combined cycle plants and their components, efficiency, and performance characteristics.**						

UNIT I

Economics of power generation: Introduction to economics of power generation; Different terms and definitions: Hydrology, Rainfall, runoff, hydrographs, flow duration curves; Cost analysis; Power plant locations; Selection of power plant equipment; Factors affecting economics of generation and distribution of power; Performance and operating characteristics of power plants; Economic load sharing; Tariff for electrical energy.

Different Power Plants: Recent developments in power plants; Geothermal power plants; Tidal power plants; Wind energy power plants; Solar power plants; **Hydroelectric power plant; Power plant planning and** Site selection: Site selection criteria; Classification of respective power plants; Estimation of power availability; Selection of turbines; Advantages and disadvantages.

UNIT II

Analysis of steam cycle: Ideal Rankine cycle; Externally irreversible Rankine cycle; Superheat; Reheat; Internally irreversible Rankine cycle; Regeneration with single and multi-bled systems: Open feed water heaters; Closed feed water heaters; Typical layout of steam power plant; Efficiency and heat rate.

Coal Handling Plant: Coal Handling: unloading, feeding, crushing, feeding system, conveyor

system, stacking system; Magnetic separator/ metal detector; Bin/chute vibratory system; Coal weighment; Coal sampling; Firefighting system; Dust suppression system; Dust extraction system; Mechanical stokers; Pulverized fuels and burners; Ash handling and disposal.

UNIT III

Solar Power Plants: Introduction; Solar collectors & its types: Flat Plate and Concentrating; Absorber Coating; Solar Pond electric power plant; Solar thermal electric conversion systems: Low temperature, medium temperature and high temperature; Solar Electric Power Generation: Solar Photovoltaics, Solar cell working and principle; Combination of solar and hydropower plants; Solar Chimney Power Plant System.

Diesel engine & Gas Turbine power plants: Introduction; Types; Layout of Diesel Engine power plant; Different components of diesel power plant; Performance Characteristics; Supercharging; Layout And components of Gas turbine power plants; Gas turbine fuels; material selection for gas turbines.

UNIT IV

Nuclear Power Plants: Basic theory and terminology; Nuclear fission and fusion processes; Fission chain reaction; Moderators; Fertile materials; Nuclear fuels; General components of nuclear reactor; Different types of reactors: PWR, BWR, GCR, LMFBR, CANDU-PHW; Disposal of nuclear waste and related issues.

Power Plant Combinations: Combination of hydro power plants with steam plants; GT-ST Combined Cycle plant; Combined cycles with heat recovery boiler; PFBC combined cycle; STIG (steam injected gas turbine) cycle; Combined cycles with multi-pressure steam systems; Combined cycle for nuclear power plants.

Text Books:

1. Power Plant Engineering by Morse
2. Power Plant Engineering by PK Nag
3. Power Plant Technology -By El-Wakil

Reference Books:

1. Power Plant Engineering -By P.C. Sharma
2. Power Plant Engineering -By Domkundwar
3. Power Plant Technology- By G.D.Rai
4. Power Plant Engineering by R.K. Rajput

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEP-322	**ACOUSTICS AND NOISE CONTROL**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose	**To enable the students to understand the various concepts relating to the control of Acoustic and Noise control. Also to understand various methods for the development of waves**						
Course Outcomes							
CO1	**To understand the students for various waves developed in Acoustic and Noise**						
CO2	**Students will be able to understand acoustic Measurements, Duct acoustics etc. and to understand various methods related to Duct Acoustic**						
CO3	**Enable the students to understand the acoustic analysis of an Automotive Exhaust System, Source Impedance, Radiation Impedance and to understand the various concepts of plane waves**						
CO4	**To understand the Kirchoff-Helmholtz integral equation, BEM, Rayleigh Integral, Oscillating Piston on a Baffle and learn about Sound Radiation from an Infinite Plate/Beam Sound Radiation from a baffled plate**						

UNIT-I

Introduction to Sound, Accoustics, Noise Pollution. Steady State/Harmonic Analysis/Phasors/Complex Exponentials. Harmonic Plane Waves, Characteristic Impedence, Plane waves in duct, Traveling waves, Standing Waves, Cut on Models induct, Dispersion.

UNIT-II

DB Arithmatic, Octane Band Frequency Analysis, Intermittent Noise, Noise Rating. Accoustic Measurements, Duct Accoustics, Transmission Loss, Insetion Loss. Transmission Matrix method for expansion chamber muffler, Electro Mechanical Analogy for lumped elements.

UNIT–III

Lumped Accoustic Elements, Helmholtz Resonator, Accoustic Analysis of an Automotive Exhaust System, Source Impedence, Radiation Impedence, Electro Accoustic Analogy for duct acoustic systems, Concentric hole cavity resonator, Spherical wave Equation, Pulsating Sphere, Spherical Wave Impedence, Limiting Case of Plane Waves.

UNIT–IV

Monopole & Dipole, Inhomogeneous Wave Equation, Greens Function, Kirchoff-Helmholtz integral equation, BEM, Rayleigh Integral, Oscillating Piston on a Baffle. Sound Radiation from an Infinite Plate/Beam Sound Radiation from a baffled plate.

Text books:

1. Accoustic and Noise Control by Prof. Abijith Sarkar, IIT Madras

2. Wang L.K., Pereira N.C., Hung Y.T., "Advanced Air and noise pollution control", Volume I andII, Humana Press, New Jersey.

Reference books:

1. Ghassemi A., "Pollution Control and Waste Minimization", Marcel Dekker, Inc., New York.
2. Singal S.P., "Noise pollution and control strategy", Alpha Science International, New Delhi.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. (6th Semester) Mechanical Engineering							
B23-MEP-324	**PRODUCT DESIGN AND DEVELOPMENT**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose	**The objective of the course is to understand the importance of design factors, manufacturing, assembly and environmental guidelines, prototyping and patenting requirements in product design, manufacturing, development and economics.**						
Course Outcomes							
CO1							
CO2	**Students will be able to explain and apply manufacturing, assembly and environmental guidelines in product design, manufacturing and development.**						
CO3	**Students will be able to apply the ergonomics and value engineering concepts in product designing.**						
CO4	**Students will be able to understand the modern approaches in product designing and development. They will also be able to understand the manufacturing and economic aspects related to a product.**						

UNIT-I

INTRODUCTION: Introduction to product design, Design by evolution and innovation, Essential factors of product design, Production consumption cycle, Flow and value addition in production consumption cycle, Morphology of design. **PRODUCT DESIGN PRACTICE AND INDUSTRY:** Product strategies, Time to market, Analysis of the product, Basic design considerations, Role of aesthetics in product design.

UNIT-II

DESIGN FOR MANUFACTURE AND ASSEMBLY: Overview and motivation, Basic method: Design guidelines: Design for assembly, Design for piece part production, Advanced method: Manufacturing cost analysis, cost driver modeling, Critique for design for assembly method.

DESIGN FOR THE ENVIRONMENT: Environmental objectives, Basic DFE methods, Design guidelines, Life cycle assessment, Techniques to reduce environmental impact.

UNIT-III

HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESIGN: Human being as applicator of forces, Anthropometry, the design of controls, the design of displays, Man/Machine information exchange, Workplace layout from ergonomic considerations.

VALUE ENGINEERING: Value engineering in product design; Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.

UNIT-IV

MODERN APPROACHES TO PRODUCT DESIGN: Concurrent design, Quality function deployment (QFD), Rapid prototyping, 3D printing, different types of 3D printing technologies.

PRODUCT DEVELOPMENT: A modern product development process, reverse engineering and redesign product development process, product life cycle, product development teams, Product development planning, Manufacturing & economic aspects of product development.

TEXT BOOKS:

1. Kail T Ulrich and Steven D Eppinger, "Product Design and Development, TMH.
2. AK Chitale and Gupta, "Product Design and Engineering, PHI.

REFERENCE BOOKS:

1. Niebel & Draper, "Product Design and Process Engineering", McGraw-Hill.
2. Kevin Otto & Kristin Wood, "Product Design-Techniques in reverse engineering and new product development" Pearson

Note: The paper setter will set the paper as per the question paper templates provided.

B23-VAC-302	Hindi Language Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time**
2	**-**	**-**	**1**	**--**	**100**	**100**	**3**

This course will be offered through NPTEL/MOOC online courses with the following link - https://onlinecourses.nptel.ac.in/noc23_hs125/preview.
The syllabus of NPTEL/MOOC platform will be acceptable. Students can also learn online from videos and internal assessment can be made in the Institute by taking an internal exam of 100 marks.

B23-VAC-304	Sanskrit Language Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time**
2	**-**	**-**	**1**	**--**	**100**	**100**	**3**
Course Outcomes **At the end of this course, student will**							
CO 1	Learn behavioural science from Bhagwat Gita						
CO 2	Learn self-awareness and spirituality from Bhagwat Gita						
CO 3	Learn mind management from Bhagwat Gita						
CO 4	Learn responsible behaviour from Bhagwat Gita						

SYLLABUS FOR SANSKRIT STUDIES

Unit 1	**BEHAVIOURAL SCIENCE** ● **Learning different personality types from Gita.** BG 14.6-8 ● Dealing with stress, depression and **self-destructive** urges. BG 2.14 ● Overcoming **procrastination and hyperactivity.** BG 18.35-36 ● **Developing *sattva* - platform of controlled action.** BG 18.33 ● Balancing physical, mental and emotional health. BG 6.16-17, 6.5 ● Increasing productivity in activity through spirituality. BG 2.47 ● **Mind Intelligence mechanism.** BG 3.42-43 ● **Tapping the power of meditation**. BG 6.10-15
Unit 2	**SELF-AWARENESS** ● **Understanding Different Layers of Self - Physical, Mental and Spiritual** – BG 2.13 ● Becoming Sensitive Towards Other Beings and Nature at Large – BG 5.18, 6.29-32 ● **Cultivating Culture of Respect** – BG 13.8-12 ● Dealing with Grief – BG 2.11, 2.27 ● **Holistic Wellbeing Through Self-Awareness** – BG 6.5, 6.7 ● Recognizing the Impermanence of the Body – BG 2.14 ● Cultivating Detachment for True Self-Awareness – BG 2.71, 5.29 ● **Connecting with the Higher Self Through Meditation** – BG 6.10 ● Transcending Ego for Inner Peace – BG 3.27 ● Self-Reflection for Personal Growth – BG 6.5 ● Overcoming False Identification with the Body – BG 2.30

	Seeing the Divine in All Beings – BG 9.22
Unit 3	**<u>MIND MANAGEMENT - ART OF MIND CONTROL</u>** ● **The Root of Frustration & Anger** – BG 2.62-63 ● Discover the Real Reason Behind Lack of Motivation – BG 3.36, 3.41 ● **Controlling the Uncontrolled Mind** – BG 6.26 ● **Understanding the Mind & Its Power** – BG 6.6, 3.42 ● Mind Like a Boat in Stormy Waters – BG 2.67 ● **Learn to Stay Calm Under Pressure** – BG 2.14, 2.56 ● The Peaceful Mind of a Wise Person – BG 2.70, 2.56 ● Freedom from Attachment = Peace – BG 2.71, 5.26 ● Peace Through Detachment – BG 2.71, 5.20
Unit 4	**<u>RESPONSIBLE ACTION</u>** ● **Understanding Intricacies of Action and Reaction - Karma, Vikarma & Akarma** – BG 4.17 ● Principles of Forbearance and Tolerance – BG 2.14, 12.13-14 ● Coping with Adversities and Reversals in Life – BG 2.14-15, 18.11 ● **Becoming Responsible in Action - Karma Yogi** – BG 3.7, 3.19, 3.30, 5.10 ● Performing Actions Without Attachment to Results – BG 2.47, 3.19 ● Acting in Accordance with Dharma – BG 3.35 ● Surrendering the Fruits of Actions to God – BG 9.22, 18.66 ● Selflessness in Actions – BG 18.9 ● Discerning Between Right and Wrong Actions – BG 18.63 ● **Balanced Approach to Work and Rest** – BG 6.17 ● Purifying Intentions Behind Actions – BG 18.11 ● **Taking Responsibility for One's Actions and Their Impact** – BG 3.16

B23-VAC-306	German Language Skills						
Lecture	**Tutorial**	**Practical**	**Credits**	**End semester Examination**	**Internal assessment**	**Total**	**Duration of exam (Hours)**
2	**0**	**0**	**1**	**-**	**100**	**100**	**3 Hrs**
Purpose	**To learn about German Language Skills**						
Course Outcomes							
CO1	**Introduce students to basic German language.**						
CO2	**Enable basic communication in German (self-introduction, daily routine, etc.).**						
CO3	**Develop foundational skills in vocabulary and grammar.**						
CO4	**Develop foundational skills in reading, writing, listening, and speaking.**						

Course Outline

Unit 1: Introduction & Basics

- German alphabet and pronunciation
- Greetings and farewells
- Introducing oneself and others
- Numbers (0–100)
- Days, months, seasons

Unit 2: Vocabulary Building I

- Family and relationships
- Professions and nationalities
- Countries and cities
- Colors and clothing
- Weather

Unit 3: Grammar I

- Nouns: gender, singular/plural
- Articles: definite (der/die/das), indefinite (ein/eine)
- Personal pronouns (ich, du, er, etc.)
- Verb conjugation (regular verbs in Präsens)
- Sentence structure: main clause word order

Grammar II

- Verbs: haben, sein, modal verbs (möchten, können)
- Question words (wer, was, wo, etc.)

- Negation (nicht, kein)
- Possessive pronouns (mein, dein, etc.)
- Accusative case basics

Unit 4: Vocabulary Building II

- Food and drink
- Daily routine
- Time and date
- House and furniture
- Hobbies and leisure

Communication Practice

- Simple dialogues (in café, at university, at home)
- Role plays (shopping, asking directions, introductions)
- Listening practice (audio exercises)
- Writing practice (short texts, filling forms)

Assessment (Optional/Recommended)

- Vocabulary quizzes
- Short written assignments
- Oral presentation or role-play
- Final test (basic grammar and vocabulary)

B23-VAC-308	Japanese Language Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**End semester Examination**	**Internal assessment**	**Total**	**Duration of exam (Hours)**
2	**0**	**0**	**1**	**-**	**100**	**100**	**3 Hrs**
Purpose	**To learn about Japanese Language Skills**						
Course Outcomes							
CO1	**Introduce students to basic Japanese language.**						
CO2	**Enable basic communication in Japanese (self-introduction, daily routine, etc.).**						
CO3	**Develop foundational skills in vocabulary and grammar.**						
CO4	**Develop foundational skills in reading, writing, listening, and speaking.**						

Course Outline

Unit 1: Introduction & Basics

- Alphabet and pronunciation
- Greetings and farewells
- Introducing oneself and others
- Numbers (0–100)
- Days, months, seasons

Unit 2: Vocabulary Building I

- Family and relationships
- Professions and nationalities
- Countries and cities
- Colors and clothing
- Weather

Unit 3: Grammar I

- Nouns: gender, singular/plural
- Articles: definite and indefinite
- Personal pronouns
- Verb conjugation (regular verbs in present tense)
- Sentence structure: main clause word order

Grammar II

- Common verbs (e.g., to be, to have, modal verbs)
- Question words
- Negation
- Possessive pronouns
- Basic cases or particles (as applicable)

Unit 4: Vocabulary Building II

- Food and drink
- Daily routine
- Time and date
- House and furniture
- Hobbies and leisure

Communication Practice

- Simple dialogues (e.g., in café, at university, at home)
- Role plays (shopping, asking directions, introductions)
- Listening practice (audio exercises)
- Writing practice (short texts, filling forms)

Assessment (Optional/Recommended)

- Vocabulary quizzes
- Short written assignments
- Oral presentation or role-play
- Final test (basic grammar and vocabulary)

B23-VAC-310	French Language Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**End semester Examination**	**Internal assessment**	**Total**	**Duration of exam (Hours)**
2	**0**	**0**	**1**	**-**	**100**	**100**	**3 Hrs**
Purpose	**To learn about French Language Skills**						
Course Outcomes							
CO1	**Introduce students to basic French language.**						
CO2	**Enable basic communication in French (self-introduction, daily routine, etc.).**						
CO3	**Develop foundational skills in vocabulary and grammar.**						
CO4	**Develop foundational skills in reading, writing, listening, and speaking**						

Course Outline

Unit 1: Introduction & Basics

- Alphabet and pronunciation
- Greetings and farewells
- Introducing oneself and others
- Numbers (0–100)
- Days, months, seasons

Unit 2: Vocabulary Building I

- Family and relationships
- Professions and nationalities
- Countries and cities
- Colors and clothing
- Weather

Unit 3: Grammar I

- Nouns: gender, singular/plural
- Articles: definite and indefinite
- Personal pronouns
- Verb conjugation (regular verbs in present tense)
- Sentence structure: main clause word order

Grammar II

- Common verbs (e.g., to be, to have, modal verbs)
- Question words
- Negation
- Possessive pronouns
- Basic cases or particles (as applicable)

Unit 4: Vocabulary Building II

- Food and drink

- Daily routine
- Time and date
- House and furniture
- Hobbies and leisure

Communication Practice

- Simple dialogues (e.g., in café, at university, at home)
- Role plays (shopping, asking directions, introductions)
- Listening practice (audio exercises)
- Writing practice (short texts, filling forms)

Assessment (Optional/Recommended)

- Vocabulary quizzes
- Short written assignments
- Oral presentation or role-play
- Final test (basic grammar and vocabulary)