Fifth Semester

B. Tech (5th Semester) Mechanical Engineering							
HM-905	**ENTREPRENEURSHIP**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To acquaint the knowledge about the entrepreneurship and entrepreneurial process in context of economic development, formalities required in launching a small enterprise, venture capital financing schemes and IPR.						
Course Outcomes							
CO1	Students will be able to understand: who the entrepreneurs are? what competencies are required to become an Entrepreneur?						
CO2	Students will have insights into the management, opportunity search, identification of a product, process of project finalization etc. required for small business enterprises.						
CO3	Students will be able to understand the meaning of small scale enterprise (SSE) and the setup formalities, operational and project management issues in the SSE.						
CO4	Students be able to know the different financial assistances available for the establishment of small scale industrial units and the IPR related issues.						

UNIT-I

Entrepreneurship: Concept and definitions, Entrepreneurship and economic development, classification and types of entrepreneurs, entrepreneurial competencies, factor affecting entrepreneurial Growth– economic, non-economic factors, EDP programmes, entrepreneurial training, traits/qualities of an entrepreneurs, manager vs entrepreneur, entrepreneurial challenges.

UNIT-II

Establishing Small Scale Enterprise: Opportunity scanning and identification, creativity and product development process, market survey and assessment, choice of technology and selection of site.

Planning a Small Scale Enterprises: Financing new/small enterprises, techno-economic feasibility assessment, preparation of business plan, forms of business organization/ownership.

UNIT–III

Small Enterprises and Enterprise Launching Formalities: Definition of small scale, rationale, objective, scopes, SSI, registration, NOC from pollution board, machinery and equipment selection, MSMEs – definition and significance in Indian economy, MSME schemes, operational issues in SSE: financial management issues, operational/project management issues in SSE, marketing management issues in SSE.

UNIT–IV

Institutional Interface for Small Scale Industry/Enterprises, Venture Capital: Concept, venture capital financing schemes offered by various financial institutions in India, legal issues–forming business entity, requirements for formation of a private/public limited company, entrepreneurship and Intellectual property rights: IPR and their importance (Patent, Copy Right, Trademarks), case studies-at least one in whole course.

Text books:

1. Entrepreneurship Development Small Business Enterprises by Poornima M Charantimath, Pearsons pub.
2. Entrepreneurship by Roy Rajiv, Oxford University Press.
3. Innovation and Entrepreneurship by Drucker. F, Peter, Harper business.
4. Entrepreneurship by Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, Tata Mc-Graw Hill Publishing Co. ltd. New Delhi.

Reference books:

1. Entrepreneurial Development by Dr. S.S. Khanka, S. Chand Publishing Company.
2. Entrepreneurship and Management of Small and Medium Enterprises by Dr. Vasant Desai, Himalaya Publishing House.

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

B. Tech (5th Semester) Mechanical Engineering							
MEC- 301	**HEAT TRANSFER**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**1**	**0**	**4**	**75**	**25**	**100**	**3**
Purpose	To build a solid foundation in heat transfer and rigorous treatment of governing equations and solution procedures.						
Course Outcomes							
CO1	After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.						
CO2	The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer.						
CO3	The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.						

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 one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, steady one dimensional heat conduction without internal heat generation, the plane slab, the cylindrical shell, the spherical shell, conduction through composite wall, critical insulation thickness, variable thermal conductivity, steady one dimensional heat conduction with uniform internal heat generation, the plane slab, the cylindrical and spherical systems, heat transfer through fins of uniform cross-section, governing equation, temperature distribution and heat dissipation rate, effectiveness and efficiency of fins.

Transient conduction: Lumped system approximation and Biot number, approximate solution to unsteady conduction heat transfer by the use of Heisler charts.

UNIT-II

Convection: Heat convection, basic equations, boundary layers, forced convection, external and internal flows, natural convective heat transfer, dimensionless parameters for forced and free convection heat transfer, boundary layer analogies, correlations for forced and free convection, approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow, 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.

UNIT-III

Radiation: Interaction of radiation with materials, definitions of radiative properties, 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, 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, radiation shields.

UNIT-IV

Heat exchangers: Types of 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.

Text books:

1. Fundamentals of Heat and Mass transfer – Frank P. Incropera, David P. Dewitt, T.L. Bergman and A.S. Lavine, Sixth Edition, Wiley Publications, 2007.
2. Heat Transfer: A Practical Approach - Yunus A Cengel, McGraw Hill, 2002.
3. Heat and Mass Transfer – P.K. Nag, Tata McGraw Hill.
4. Heat Transfer – J.P. Holman, Eighth Edition, McGraw Hill, 1997.

Reference books:

5. Heat Transfer – A. Bejan, John Wiley, 1993.
6. A Text book of Heat Transfer - S.P Sukhatme, University press.
7. Principles of Heat Transfer – Massoud Kaviany, John Wiley, 2002.
8. Heat and Mass Transfer - D.S Kumar, S.K. Kataria & Sons.
9. Heat Transfer – Y.V.C. Rao, University Press.

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

B. Tech (5th Semester) Mechanical Engineering							
MEC-303	**PRODUCTION TECHNOLOGY**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose:	To acquaint the knowledge of different type of machines and machine tools used in machining of metals, cutting tools used in different operations, work holding devices and CNC machines.						
Course Outcomes							
CO 1	After completing the course, the students will be capable of knowing different machines, machine tools and the machining operations.						
CO 2	The students will be able to analyze the machining operations.						
CO 3	The students will have a knowledge of different types of cutting tools and cutting fluids used in machining.						
CO 4	The students will have understanding of metrology and inspection tools with their applications.						
CO 5	The students will know about various thread operations, use of different workholding devices and different gear manufacturing processes.						
CO 6	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, cutting tools, cutting conditions, theory of chip formation in metal cutting: orthogonal cutting model, actual chip formation, forces relationships and the merchant equation: forces in metal cutting, the merchant equation, power and energy relationships in machining, cutting temperatures.

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, grinding machines: types, wet and dry grinding, abrasives, grit, grade and structure of wheels, selection of grinding wheels.

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, inspection of screw threads, surface finish measurement by contact and non-contact methods, tolerance analysis in manufacturing and assembly.

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.

Workholding devices for machine tools: Introduction, conventional fixture design, tool design steps, clamping considerations, chip disposal, unloading and loading time, example of jig design, types of jigs, conventional fixtures, modular fixturing, setup and changeover: single-minute-exchange-of-die (SMED),

clamps, other workholding devices: assembly jigs, magnetic workholders, electrostatic workholders, economic justification of jigs and fixtures.

UNIT-IV

Gear manufacturing and finishing: Introduction to different types of gears, terminology, methods of gears manufacturing, gear forming: selecting a form gear cutter for cutting spur gears, selecting gear cutter for cutting helical or spiral gear, broaching of gears, generating methods: gear shaper process, rack planning process, gear hobbing process. Gear finishing operations: Shaving, burnishing, grinding, lapping, honing, gears inspection.

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 Technology by R. K. Jain, Khanna Publishers.
4. Machine Tools by R. Kesavan & B. Vijaya Ramnath, Laxmi Publications.
5. 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							
MEC-305	**MECHANICAL VIBRATIONS AND TRIBOLOGY**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total Time**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose:	To understand the vibration systems with different degrees of freedom in different modes and conditions and the basics of tribology.						
Course Outcomes							
CO1	The students will be capable of understanding the vibration fundamentals for a single degree of freedom (D.O.F.) system under free and damped vibrations.						
CO2	The students will be able to analyze different types of forced vibration system in single degree of freedom (D.O.F.) and damped, undamped, free and forced systems with two D.O.F.						
CO3	The students will understand the principal modes of vibrations using different methods for various combinations of spring-mass and rotor-shaft systems and to study transverse, longitudinal and torsional vibration for beams, bars and shafts respectively.						
CO4	The students will understand the fundamentals of tribology, lubrication, friction and wear.						

UNIT-I

Fundamentals: Introduction, elements of a vibratory system, periodic and S.H.M., degrees of freedom (DOF), types of vibrations, work done by a harmonic force, beats, problems.

Free vibration systems with single degree of freedom

Undamped systems: Introduction, differential equations, torsional vibrations, spring and shaft combinations: series & parallel, linear and torsional systems, compound pendulum, bifilar and trifilar suspensions, problems.

Damped systems: Introduction, types of damping, differential equations of damped free vibrations, initial conditions, logarithmic decrement, vibrational energy, problems.

UNIT-II

Forced vibration systems with single degree of freedom: Introduction, excitation and sources, equations of motion, rotating and reciprocating unbalanced system, support motion, vibration isolation, force and motion transmissibility, forced vibration system with different types of damping, vibration measuring instruments, resonance, bandwidth, quality factor and half power points, critical speed of shaft with and without damping with single and multiple discs, problems.

Two degree of freedom system: Introduction, torsional vibrations, principal modes of vibrations for two D.O.F., damped and undamped forced and free vibrations, semi-definite systems, co-ordinate coupling, spring and mass type vibration absorber, problems.

UNIT-III

Multi-degree of freedom systems: Introduction, principal modes of vibrations for three or more DOF, influence coefficients, orthogonality principle, matrix method, matrix iteration method, Dunkerley's equation, Holzer's Method, Rayleigh Method, Rayleigh-Ritz method, Stodola method, problems.

Continuous systems: Introduction, lateral vibrations of strings, longitudinal vibrations of bars, transverse vibration of beams, torsional vibration of uniform shafts, problems.

UNIT-IV

Tribology: Introduction, tribology in design, tribology in industry, economic aspects.

Lubrication: Introduction, basic modes of lubrication, lubricants, properties of lubricants: physical and chemical, types of additives, extreme pressure lubricants, recycling of used oils and oil conservation, disposal of scrap oil, oil emulsion.

Friction and wear: Introduction, laws of friction, kinds of friction, causes of friction, friction measurement, theories of friction, effect of surface preparation. Introduction to wear, types of wear, various factors affecting wear, measurement of wear, wear between solids and liquids, theories of wear.

Text Books:

1. Mechanical Vibrations by G. K. Grover, Nem Chand and Bros., Roorkee
2. Elements of Mechanical Vibrations by Meirovitch, McGraw Hill
3. Introductory course on theory and practice of Mechanical Vibration by J.S. Rao and K.Gupta, New Age International.
4. Friction and wear of Materials by E. Robinowicz, Johan Wiley
5. Tribology an Introduction by Sushil Kumar Srivastava
6. Introduction to Tribology and Bearings by B. C. Majumdar, S. Chand and Company Ltd. New Delhi.

Reference Books:

1. Mechanical Vibrations by S. S. Rao, Pearson Education Inc. Dorling Kindersley (India) Pvt. Ltd. New Delhi.
2. Mechanical Vibrations by V.P. Singh, Dhanpat Rai & Co. Pvt. Ltd., Delhi
3. Engineering Tribology by Prashant Sahoo, PHI publications.
4. Principles of Tribology by J. Hailing, McMillan Press Ltd.

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

B. Tech. (5th Semester) Mechanical Engineering								
MEC- 307L	**HEAT TRANSFER LAB**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	To impart practical knowledge of different modes of heat transfer by conducting experiments.							
Course Outcomes								
CO1	Design and conduct experiments, acquire data, analyze and interpret data.							
CO2	Measure the thermal conductivity of metal rod, insulating material and liquids etc.							
CO3	Understand the concept of composite wall and determine its thermal resistance.							
CO4	Measure heat transfer coefficients in free and forced convection.							
CO5	Measure the performance of a heat exchanger.							
CO6	Determine the Stefan Bolzman constant and emissivity.							

List of Experiments:

1. To determine the thermal conductivity of a metal rod.
2. To determine the thermal conductivity of an insulating slab.
3. To determine the thermal conductivity of a liquid using Guard plate method.
4. To determine the thermal conductivity of an insulating powder.
5. To determine the thermal resistance of a composite wall.
6. To plot the temperature distribution of a pin fin in free-convection.
7. To plot the temperature distribution of a pin fin in forced-convection.
8. To study the forced convection heat transfer from a cylindrical surface.
9. To determine the effectiveness of a concentric tube heat exchanger in a parallel flow arrangement.
10. To determine the effectiveness of a concentric tube heat exchanger in a counter flow arrangement.
11. To determine the Stefan-Boltzman constant.
12. To determine the emissivity of a given plate.
13. To determine the critical heat flux of a given wire.
14. To study the performance of an evacuated tube based solar water heater.

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								
MEC-309L	**PRODUCTION TECHNOLOGY LAB**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	To impart practical knowledge of various measuring instruments, machining and welding operations by performing experiments.							
Course Outcomes								
CO 1	The students will be able to gain the practical knowledge of different measuring instruments used in machining operations.							
CO 1	The students will be able to perform different machining operations for the preparation of a job piece.							
CO 2	The students will be able to prepare various jobs using TIG/MIG welding.							
CO 3	The students will be trained for manufacturing the job pieces on CNC lathe and CNC milling.							

LIST OF EXPERIMENTS:

1. Study of linear, angular measuring devices and to measure the linear and angular dimensions using various equipment's.
2. 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).
3. To prepare a job on a lathe having various operations viz. drilling, boring, taper turning, thread cutting, knurling, etc.
4. Demonstration of formation of cutting parameters of single point cutting tool using bench grinder / tool & cutter grinder.
5. 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.
6. Introduction to various grinding wheels and demonstration on the cylindrical and surface grinder.
7. To demonstrate surface milling /slot milling.
8. To cut gear teeth on milling machine using dividing head.
9. To cut V Groove/ dovetail / Rectangular groove using a shaper.
10. To prepare a useful product containing different types of welded joints using simple arc/TIG/MIG welding set.
11. To cut external threads on a lathe and practice thread measurements.
12. 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.
13. 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

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

.**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								
MEC-311L	**MECHANICAL VIBRATIONS AND TRIBOLOGY LAB**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total Time**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose:	To provide practical knowledge of free and forced vibration system fundamentals and the mechanisms of friction, wear and lubrication.							
Course Outcomes								
CO1	The students will be able to know practically the concepts of free and forced vibrations for a spring mass system and will determine the natural frequency.							
CO2	The students will be able to diagnose the machinery faults, there causes and sources using Machinery Fault Simulator (MFS).							
CO3	The students will understand the concept of sliding wear and abrasive wear using wear and friction monitoring apparatus and dry abrasion tester respectively.							
CO4	The students will be capable of measuring the extreme pressure properties of different lubricants using four ball tester.							

LIST OF EXPERIMENTS:

1. To study undamped free vibrations and determine the natural frequency of:
   1.1 Spring mass system
   1.2 Simple Pendulum
   1.3 Torsional spring type double pendulum and compare them with theoretical values.
2. To study the torsional vibration of a single rotor shaft system and determine the natural frequency.
3. To study the free vibration of system for different damper settings. Draw decay curve and determine the log decrement and damping factor. Find also the natural frequency.
4. To verify the Dunkerley's rule.
5. To determine the radius of gyration for:
   5.1 Bifilar suspension.
   5.2 Compound pendulum.
   5.3 Trifilar suspension.
6. To study the forced vibration system with damping, Load magnification factor vs. Frequency and phase angle vs frequency curves. Also determine the damping factor.
7. To find out and locate machinery faults viz. vibrations and unbalancing using Machinery Fault Simulator (MFS) in:
   7.1 Direct Driven reciprocating pump;
   7.2 Direct Driven centrifugal pump;
   7.3 Defective straight tooth gearbox pinions.
8. To determine the wear rate, friction force and coefficient of friction of a metallic pin/ball by using wear and friction monitor apparatus.
9. To determine abrasion index of a material with the help of dry abrasion test rig.
10. To evaluate the wear and extreme pressure properties of a lubricating oil by using four ball tester.
11. To determine the roughness of a specimen using surface roughness tester.

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								
MEC-313 L	**PROJECT-I**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total Time**	**Time (Hrs.)**
0	**0**	**2**	**1**	**--**	**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 maximum number of students in a group should not exceed four.

	B. Tech. (5th Semester) Mechanical Engineering							
MEC-315	**INDUSTRIAL TRAINING-II**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**--**	**--**	**100**	**--**	**100**	**--**
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								
CO 1	The students could be capable of self-improvement through continuous professional development and life-long learning.							
CO 2	The students will be aware about the social, cultural, global and environmental responsibility as an engineer.							
CO 3	The students will be up-to-date with all the latest changes in technological world.							

Note: MEC-315 is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

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							
MC-903	**ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**--**	**100**	**--**	**--**	**100**	**3**
Purpose	To impart basic principles of thought process, reasoning and inferencing.							
Course Outcomes								
CO 1	The students will be able to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.							

Course Contents

- Basic structure of Indian Knowledge System: अष्टादशविद्या -४वेद,४उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थापत्य आदि) ६वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) ४ उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
- Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan
- Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan
- Fritzof Capra, *Tao of Physics*
- Fritzof Capra, *The Wave of life*
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, Vidyanidhi Prakashan, Delhi 2016
- RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, Vidyanidhi Prakashan, Delhi 2016
- P B Sharma (English translation), *Shodashang Hridayan*

Pedagogy: Problem based learning, group discussions, collaborative mini projects.

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

Sixth Semester

B. Tech (6th Semester) Mechanical Engineering							
HM-901	**ORGANIZATIONAL BEHAVIOUR**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose:	To make the students conversant with the basics concepts of organizational culture and behavior for nurturing their managerial skills.						
Course Outcomes							
CO 1	An overview about organizational behavior as a discipline and understanding the concept of individual behavior.						
CO 2	Understand the concept and importance of personality, emotions and its importance in decision making and effective leadership.						
CO 3	Enabling the students to know about the importance of effective motivation and its contribution in group dynamics and resolving conflicts.						
CO 4	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, foundations or approaches to organizational behavior, challenges and opportunities for OB.

Foundation of individual behavior: Biographical characteristics, concept of abilities and learning, learning and learning cycle, components of learning, 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, employee recognition and involvement program.

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

UNIT-IV

Introduction to Organizational Communication: Meaning and importance of communication process, importance of organizational communication, 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: McGraw-Hill 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.

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

B. Tech. (6th Semester) Mechanical Engineering							
MEC-302	**MANUFACTURING TECHNOLOGY**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose:	To build a foundation in different manufacturing processes related to castings, metal forming, joining, powder metallurgy and plastic material shaping processes.						
Course Outcomes							
CO 1	After completing the course, students will be able to understand the casting fundamentals, and different casting processes.						
CO 2	The students will be familiarized with different metal forming processes and capable of doing analysis.						
CO 3	The students will understand different welding processes with their applications.						
CO 4	The student will have the basis understanding of powder metallurgy processes and different plastic shaping processes.						

UNIT-I

Fundamentals of castings: Introduction to casting: basic requirements of casting processes, casting terminology, solidification process: cooling curves, prediction of solidification time, the cast structure, molten metal problems, fluidity and pouring temperature, role of gating system, solidification shrinkage, riser and riser design, risering aids, Patterns, design considerations in castings.

Expandable-mold casting processes: Sand casting, cores and core making, other expendable-mold processes with multiple use patterns, expendable-mold processes with multiple use patterns, shakeout, cleaning and finishing. **Multiple-use-mold casting processes**: Permanent mold casting, die casting, squeeze casting and semisolid metal casting, centrifugal casting, cleaning treating and heat treating of castings, automation in foundry operations.

UNIT-II

Metal forming processes: classifications of metal forming processes, bulk deformation processes, material behavior in metal forming, temperature in metal forming, rolling: flat rolling and its analysis, shape rolling, rolling mills, forging: open-die forging, impression-die forging, flashless forging, forging hammers, presses, and dies, extrusion: types of extrusion, analysis of extrusion, extrusion dies and presses, defects in extruded products, wire and bar drawing, analysis of drawing, drawing practice, tube drawing

Sheet metal working: Cutting operations: shearing, blanking, and punching, engineering analysis of sheet-metal cutting, other sheet-metal-cutting operations, bending operations: v-bending and edge bending, engineering analysis of bending, drawing: mechanics of drawing, engineering analysis of drawing, defects in drawing.

UNIT-III

Joining processes: Principles of fusion welding processes, arc welding processes-consumable electrodes: shielded metal arc welding, gas metal arc welding, flux-cored arc welding, submerged arc welding, Arc welding processes-non-consumable electrodes: gas tungsten arc welding, plasma arc welding, resistance welding processes, other fusion-welding processes: electron-beam welding, laser-beam welding, electro-slag welding, thermit welding.

Principles of solid state welding processes: friction welding, explosive welding, ultrasonic welding processes. **Brazing, soldering, and adhesive bonding:** Principles of adhesive, brazing and soldering processes, origins of welding defects.

UNIT-IV

Powder metallurgy: Characterization of engineering powders: geometric features, other features production of metallic powders: atomization: other production methods, conventional pressing and sintering: blending and mixing of the powders, compaction, sintering, heat treatment and finishing, design considerations in powder metallurgy.

Shaping processes for plastics: Properties of polymer melts, extrusion, production of sheet and film, fiber and filament production (spinning), coating processes, injection molding, compression and transfer molding, blow molding and rotational molding, thermoforming.

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. Principles of Manufacturing Materials & Processes by Campbell J. S., Publisher – Mc Graw Hill.
4. Production Technology by R. K. Jain, Khanna Publishers
5. Manufacturing Technology-Foundry, Forming and Welding by P.N. Rao, Tata McGraw Hill
6. Advanced Manufacturing Process by Hofy, H.E., B and H Publication.
7. Manufacturing Science by Ghosh, A. and Mullik, A, East –West private Limited.

Reference Books:

1. Welding and Welding Technology by Richard L. Little Tata McGraw Hill Ltd.
2. Manufacturing Processes and Systems by Ostwald Phillip F., Munoz Jairo, John Wiley & Sons
3. Elements of Manufacturing Processes by B.S. Nagendra Parasher, RK Mittal, PHI N. Delhi

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

B. Tech. (6th Semester) Mechanical Engineering							
MEC-304	**DESIGN OF MACHINE ELEMENTS**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**4**	**0**	**6**	**75**	**25**	**100**	**4**
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 i.e. bolted, riveted joint and welded joint and the problems related to the design of springs under different loading conditions.						
CO3	The students could 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

Bolted, riveted and welded Joints: Bolt of uniform strength**,** bolted joint- simple analysis, eccentrically loaded bolted 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 remidies.

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. Mechanical Design of Machine Elements and Machines by Collins and Busby, Wiley India Pvt. Ltd.
3. Machine Design by U.C. Jindal, Pearsons publications.
4. 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.

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

B. Tech. (6th Semester) Mechanical Engineering								
MEC-310 L	**PROJECT-II**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total Time**	**Time (Hrs.)**
0	**0**	**6**	**3**	**--**	**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 analysis based software projects undergone in the previous semester can be extended to its fabrication i.e. functional machine/product in this semester. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

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

B. Tech. (6th Semester) Mechanical Engineering							
MEP-302	**INTERNAL COMBUSTION ENGINES**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**1**	**0**	**4**	**75**	**25**	**100**	**3**
Purpose:	To provide the detailed understanding of internal combustion engine, air compressors and gas turbines mainly 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. Also 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; Wankle 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 Semester) Mechanical Engineering							
MEP-304	**GAS DYNAMICS AND JET PROPULSION**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**1**	**0**	**4**	**75**	**25**	**100**	**3**
Purpose:	To familiarize the students for the concept of compressible and incompressible flows and to understand the aircraft and rocket propulsion.						
Course Outcomes							
CO 1	To enable the students to understand compressible flow fundamentals, Mach number, types of waves and effect of Mach number on compressibility.						
CO 2	Equip the students for compressible flow with friction and its effect in flow through nozzles. Also to understand the effect of friction in flow through nozzles.						
CO 3	Students will understand the concepts of normal and oblique shock in compressible flow. Also to study Rayleigh line and Rayleigh flow equation.						
CO 4	Students will learn the aircraft propulsion systems and rocket propulsion with their applications. Also to learn the solid and liquid propellants.						

UNIT-I

Compressible flow – fundamentals: Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility

UNIT-II

Flow through variable area ducts: Isentropic flow through variable area ducts, T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.

UNIT-III

Flow through constant area ducts: Flow in constant area ducts with friction (Fanno flow) - Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer.

Normal and oblique shock: Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl – Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock. Flow with Oblique Shock – Fundamental relations, Prandtl‟s equation, Variation of flow parameters.

UNIT-IV

Propulsion: Aircraft propulsion – types of jet engines – study of turbojet engine components – diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of turbo jet engines – thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbo jet engine, ram jet and pulse jet engines. Rocket propulsion – rocket engines thrust equation – effective jet velocity specific impulse – rocket engine performance, solid and liquid propellants.

Text Books:

1. Fundamental of compressible flow with Aircraft and Rocket propulsion by S.M., Yahya, New Age International (p) Ltd., New Delhi.
2. Compressible fluid flow by Patrich.H. Oosthvizen, William E.Carscallen, McGraw-Hill.
3. Gas turbine theory by Cohen.H., Rogers R.E.C and Sravanamutoo, Addison Wesley Ltd.

Reference Books:

1. Gas Turbines by V. Ganesan, Tata McGraw-Hill, New Delhi.
2. Gas Dynamics by E. Rathakrishnan, Prentice Hall of India, New Delhi.

B. Tech (6th Semester) Mechanical Engineering							
MEP-306	**Design of Transmission Systems**						
L	**T**	**P**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**1**	**0**	**4**	**75**	**25**	**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	The students will be capable of designing and selection of belt drives, pulleys and the chain drives from manufacturer's catalogue.						
CO2	The students will be able to understand the mechanism of manual transmission, clutch synchronization and gear drives.						
CO4	The students will be able to apply the Lewi's and Buckingam's equations for the design of spur, helical and bevel gears.						
CO5	The students will be capable of designing worm gear based on strength rating, wear rating and thermal rating and to understand the selection of belts and chain drives from manufacturer's catalogue.						
CO6	The students will be able to understand about the structure of torque converters, torque formulation and torque capacity.						
CO7	The students will be capable of designing the gear boxes, couplings and their selection for real application.						

UNIT-I

Flat belt drives and pulleys: Introduction, Selection of flat belts from manufacturer's catalogue, Pulleys for flat belts. **V-Belts and pulley:** Selection of V-Belts and V-grooved pulley. **Chain Drives:** Roller chains, geometric relationships, polygonal effect, power rating, sprocket wheels, design of chain drives, chain lubrication.

Manual transmissions: Powertrain layout and manual transmission structure, power flows and gear ratios.

UNIT-II

Manual transmission clutches: Clutch structure, clutch torque capacity, synchronizer and synchronization: shift without synchronizer, shift with synchronizer, equivalent mass moment of inertia, equation of motion during synchronization, condition for synchronization, shifting mechanisms.

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 gears: Geometry and nomenclature, force analysis, beam strength of bevel gears, effective load on gear tooth, wear strength of bevel gears, design procedure. **Design of worm gears:** Terminology, force analysis, friction in worm gears, material selection, strength rating and wear rating, thermal considerations and design procedure.

Torque converters: Torque converter structure and functions: torque multiplication and fluid coupling, torque converter locking up, automatic transmission fluid (ATF) circulation and torque formulation, torque capacity and input–output characteristics.

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.

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.

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, 4th 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							
MEP-308	**Composite Materials**						
L	**T**	**P**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**1**	**0**	**4**	**75**	**25**	**100**	**3**
Purpose	To acquaint with the knowledge of different composite materials manufacturing techniques and familiarization with the basic expressions and methods used in the mechanics of composite structures, characterization techniques and understanding of practical implementation.						
Course Outcomes							
CO 1	Students will be able to understand the different reinforcement and matrix material with their practical application.						
CO 2	Students will understand different composite fabrication techniques and will be able to analyse the behaviour of unidirectional composites at micro and macro level.						
CO 3	Students will be able to determine the stresses and strains in the short fiber reinforced composites and laminated composites.						
CO 4	Students will understand different experimental techniques for physical and mechanical characterization and different non-destructive techniques.						

Unit- I

Introduction: Definitions, characteristics, classification, particulate composites, fiber-reinforced composites, applications of fiber composites, Advance fibers: glass fibers, carbon and graphite fibers, aramid fibers, boron fibers, other fibers, matrix materials.

Emerging composite materials: Nanocomposites, carbon-carbon composites, bio-composites, composites in "smart" structures.

Unit- II

Fabrication of composites: Fabrication of thermosetting resin Matrix composites: Hand lay-up technique, bag molding processes, resin transfer molding, filament winding, pultrusion; Fabrication of thermoplastic-resin matrix composites (Short-fiber composites), Fabrication of Metal matrix and ceramic matrix composites.

Behavior of unidirectional composites: Nomenclature, volume and void fraction, longitudinal behavior of unidirectional composites, transverse stiffness and strength, failure modes, expansion co-efficient and transport properties.

Unit-III

Short-fiber composites: Introduction, theories of stress transfer: approximate analysis of stress transfer, stress distribution from finite-element analysis, average fiber stress. Modulus and strength of short-fiber composites: prediction of modulus, prediction of strength, effect of matrix ductility.

Analysis of laminated composites: Introduction, laminate strains, variation of stresses in laminates, resultant forces and moments, laminate description system, determination of laminate stresses and strains, analysis of laminates after initial failure, performance of fiber composites: fatigue and impact effects.

Unit-IV

Experimental characterization of composites: Introduction, measurement of physical properties: density, constituent weight and volume fractions, void volume fraction, thermal expansion coefficient,

moisture absorption and diffusivity and moisture expansion co-efficient, measurement of mechanical properties: properties in tension, compression, in-place shear properties.

Damage identification using non-destructive evaluation techniques:- Ultrasonic, X-Radiography, Laser Shearography, Thermography.

Text Books:

1. Analysis and performance of Fiber Composites by Bhagwan D. Agarwal, Lawrence J. Broutman, K. Chandrashekhara, Wiley India Pvt. Ltd., India.
2. Fiber Reinforced Composites: Materials Manufacturing and Design by P.K. Mallick, 3rd Edition, CRC Press.
3. Mechanics of Composite Materials by Autar K. Kaw, 2nd Edition, CRC Taylor and Francis Group.
4. Composite Materials, Design and Applications by Daniel Gay, Suong V. Hoa, 2nd Edition, CRC Taylor and Francis Group.

Reference Books:

1. Mechanics of Composite Materials by R. M. Jones, CRC Press.
2. Fibrous Materials by K. K. Chawla, Cambridge University Press.

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

B. Tech. (6th Semester) Mechanical Engineering							
MEP-310	**REFRIGERATION AND AIR CONDITIONING**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**1**	**0**	**4**	**75**	**25**	**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							
CO 1	Students should be able to understand different refrigeration processes like ice refrigeration, evaporative refrigeration, refrigeration by expansion of air, steam jet refrigeration systems etc.						
CO 2	Students will identify, formulate and solve air refrigeration, vapour refrigeration and vapour absorption refrigeration problems.						
CO 3	Students will identify and understand refrigerants and their uses as per their properties and environmental effects etc.						
CO 4	Students should grab the knowledge of psychometric properties, psychometric chart and its use for different cooling and heating processes along with humidification and dehumidification.						
CO 5	Students should be able to design various air-conditioning systems by including the internal and external heat gain.						

REFRIGERATION

UNIT-I

Introduction: Basics of heat pump & 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, air refrigeration in air craft, necessity of cooling the aircraft.

UNIT-II

Simple vapour compression refrigeration system: Simple vapour compression refrigeration system, different compression processes (wet, dry and saturated Compression, superheated compression), Limitations of vapour compression refrigeration system if used on reverse Carnot cycle, 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.

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.

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.

AIR-CONDITIONING

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.

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.

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 Ananthana and Rayanan, 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							
MEP-312	**PRODUCT ENGINEERING**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**1**	**0**	**4**	**75**	**25**	**100**	**3**
Purpose	To acquaint the students with the knowledge of engineering techniques used to produce an engineering product.						
Course Outcomes							
CO1	Students will be able to attain the theoretical knowledge of different work, method and time study, recording charts and techniques.						
CO2	Students will be able to understand the importance of inventory control and solve the problems related queuing theory.						
CO3	Students will be able to attain the theoretical knowledge of sales forecasting and understand the network analysis representations.						
CO4	Students will be familiarize with the concept of value engineering and different modern approaches of product design.						

Unit-I

Introduction to Work Study: Work study, human considerations in work study, relationship of work-study person with management, relationship of work-study person and supervisor, Method Study: procedure of method study, Therbligs, Motion study, cycle graph and chronocycle graph: equipment used, procedure and uses, principles of motion economy, Work measurement: definitions and objectives, time-study procedures, work-measurement techniques, job selection for work measurement, equipment's and forms used for time study, performance rating, determination of normal time and standard time allowances, pre-determined motion time systems.

Ergonomics: Human being as applicator of forces, Anthropometry, the design of controls, the design of displays, Man/Machine information exchange, Workplace layout from ergonomic considerations.

Unit-II

Inventory Control: Functions of inventory; Types of inventory; Control importance functions, Inventory costs, factors affecting inventory control, various inventory controls models; A.B.C. analysis, lead-time calculations.

Queuing Theory: Introduction, applications of Queuing theory, waiting time and idle time cost, Single channel queuing theory and multi-channel queuing theory with Poisson arrivals and exponential services, numerical on single channel and multi channels theory.

Unit-III

Sales Forecasting: Introduction, objectives and importance of sales forecasting, Types of forecasting, Methods of sales forecasting, Collective opinion method, Delphi technique, economic indicator method; Regression analysis.

Network Analysis: Phases of project management, network representation, techniques for drawing network, numbering of events (Fulkersen rule), PERT calculations, Critical path method (CPM): Forward pass computation, backward pass computation, computation of float and slack time, critical

path, time cost optimization algorithm, updating a project, resource allocation and scheduling, Management operation system technique (MOST).

Unit-IV

Value Engineering: Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, value analysis job plan, creativity, steps to problem solving and value analysis, value analysis tests, value engineering idea generation check list, Cost reduction through value engineering-case study, materials and process selection in value engineering.

Modern Approaches: Concurrent engineering, Quality function deployment (QFD), Reverse engineering, 3D printing.

Text Books:

1. Work study and Ergonomics by Prof. P.C. Tewari, Ane Books Pvt. Ltd., New Delhi-110002.
2. Operations Research by A. M., Natarajan and P. Balasubramanie, Pearson Education India.
3. Industrial Engineering and Production Management by TelSang Martand, S. Chand and company Ltd.

Reference Books:

1. Operation Research by Prem Kumar Gupta and D.S. Heera, S. Chand Publications.
2. Motion and time study: Improving Productivity by Marvin E, Mundel and David L, Pearson Education.
3. Work study and Ergonomics by S. K. Sharma and Savita Sharma, S. K. Kataria and Sons, Delhi.
4. Product design and engineering by A. K. Chitale and Gupta, PHI

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

B. Tech. (6th Semester) Mechanical Engineering								
MEC-306 L	**MECHANICAL ENGINEERING LAB-I**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total Time**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose:	To provide practical knowledge in the concerned subject that a student opt from the program electives offered in the curriculum.							

INTERNAL COMBUSTION ENGINES PRACTICALS:

COURSE OUTCOMES:

CO 1: The students will be able to understand the principles, construction and working of S.I. and C.I. engines.

CO 2: The students will be familiarized with fuel injection systems, lubrication and cooling systems.

CO 3: The students will also be able to calculate the performance parameters of reciprocating air compressor, petrol and diesel engines.

LIST OF EXPERIMENTS

1. To make a trial on single cylinder 4-stroke Diesel Engine to calculate B. H. P., S.F.C. and to draw its characteristics curves.
2. To make a trial on 4-stroke high-speed diesel engine and to draw its Heat Balance Sheet.
3. To make a trial on Wiley's jeep Engine at constant speed to calculate B. H. P., S. F. C. Thermal efficiency and to draw its characteristic Curves.
4. To make Morse Test to calculate IHP of the multi cylinder petrol engine and to determine its mechanical efficiency.
5. To calculate the isothermal efficiency and volumetric efficiency of a 2 stage reciprocating air compressor.
6. To find out the efficiency of an air Blower.
7. To make a trial on the Boiler to calculate equivalent evaporation and efficiency of the boiler.
8. To study the following models;
   (a) Gas Turbine (b) Wankle Engine.
9. To study
   (a) Lubrication and cooling systems employed in various I. C. Engines in the Lab
   (b) Braking system of automobile in the lab
10. To study a Carburetor.
11. To study (I) the Fuel Injection System of a C. I. Engine. (II) Battery Ignition system of a S.I. Engine
12. To study Cooling Tower.
13. To make a trial with multi-cylinder four stroke vertical Diesel Engine test Rig with Hydraulic Dynamometer.

DESIGN OF TRANSMISSION SYSTEMS PRACTICALS:

COURSE OUTCOMES:

CO 1: The students will be familiarized with different modules of SOLIDWORKS/ANSYS for the analysis and simulation of transmission elements.

CO 2: The students will be able to apply the design principles and concepts in designing and simulation of various transmission elements of an automobile under different operating conditions.

CO 3: The students will be capable of understanding the constructional details and working of different transmission components used in automobiles.

LIST OF EXPERIMENTS

1. To model and simulate the V-belt drive/belt conveyor.
2. To simulate and analyze the rack and pinion arrangement under different loading conditions.
3. Static structural analysis of different gears.
4. Transient and explicit analysis on transmission system gears.
5. To simulate and analyze rigid flange coupling and bushed-pin flexible coupling.
6. To simulate and analyze the camshaft.
7. Static structure and fatigue analysis of crank shaft.
8. To study the construction details, working principles and operations of different types of automotive clutches.
9. To study the direct-shift continuous variable transmission (CVT) system.
10. To study the constructional details, working principles and operations of different types of automotive brakes.

GAS DYNAMICS AND JET PROPULSION PRACTICALS

COURSE OUTCOMES:

CO 1: Students will be able to simulate and analyse the flow through the nozzle and an airfoil.

CO 2: Students will be able to understand the simulation of vortex shedding phenomenon.

CO 3: Students will have an experience to validate the computer program for coutte flow.

CO 4: Students will be able to validate the computer based program of fully developed laminar flow in a pipe.

LIST OF EXPERIMENTS

1. To simulate and analyze the compressible flow through a nozzle.
2. To simulate and analyze the transonic flow over an airfoil.
3. To simulate vortex shedding phenomenon over a cylinder in laminar flow.
4. To make and validate a computer program for the coutte flow.
5. To make and validate a computer program for the fully developed laminar flow in circular pipe.
6. To simulate and analyze the laminar flow pipe.

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

B. Tech. (6th Semester) Mechanical Engineering								
MEC-308 L	**MECHANICAL ENGINEERING LAB-II**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total Time**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose:	To provide practical knowledge in the concerned subject that a student opt from the program electives offered in the curriculum.							

COMPOSITE MATERIALS PRACTICALS

COURSE OUTCOMES:

CO 1: The students will have a practical exposure with different types of composites development techniques.

CO 2: The students will be able to practically implement the theoretical knowledge in the fabrication of different types of composites such as polymer matrix composites, MMC etc.

CO 3: The students will be capable of analysing the physical, mechanical and tribological behavior of the developed composites.

LIST OF EXPERIMENTS

1. To study the hot compression molding technique for the preparation of thermosetting-resin matrix composites.
2. To develop the advanced fiber reinforced polymer composites and characterize for their physical properties (density, constituent weight and volume fractions, void volume fraction, thermal expansion coefficients, moisture absorption and diffusivity, moisture expansion coefficients).
3. To find the hardness and tensile and flexural properties of the advanced fiber reinforced polymer composites.
4. To develop the particle reinforced polymer composites and characterize for their physical properties (density, constituent weight and volume fractions, void volume fraction, thermal expansion coefficients, moisture absorption and diffusivity, moisture expansion coefficients).
5. To develop the Al metal-matrix composites using friction stir casting and characterize for various mechanical properties.
6. To find the friction and wear properties of Al metal matrix composites using pin-on-disc apparatus.
7. To find the hardness and tensile and flexural properties of the particle reinforced polymer composites.
8. To find the friction and wear properties of fiber reinforced/particle reinforced polymer composites using pin-on-disc apparatus.

REFRIGERATION AND AIR CONDITIONING PRACTICALS

COURSE OUTCOMES:

CO 1: The students will be able to understand the basics and working principle of water cooler.

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 various components in room air conditioner.
9. To find RH of atmospheric air by using Sling Psychrometer.
10. To find performance of a refrigeration test rig system by using different expansion devices.
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.

PRODUCT ENGINEERING PRACTICALS

COURSE OUTCOMES:

CO 1: The students will be able to understand the concept of P-Chart and C-Chart.

CO 2: The students will understand the normal distribution and universal distribution.

CO 3: The students will be able to interpret the two handed process chart and Multi activity chart (Man-Machine Chart).

CO 4: The students will be able to interpret the concept of $\bar{X}$, R Charts and Process capability.

LIST OF EXPERIMENTS

1. To draw left and right hand process charts and to conduct time study for the bolt, washer & nut assembly of present and improved methods.
2. To show that sample means for a normal universe follow a normal distribution.
3. To learn performance rating through observation of the activity of dealing pack of 52 playing cards.
4. To study the changes in heart beat rate for different subjects using Treadmill.
5. To plot the operating charters tic curve for a single sampling attributes plan of a given lot of plastic balls and to compare the actual O.C curve with theoretical O.C curve.
6. To study the changes in heart beat rate for different subjects using Ergocycle.
7. To draw P-Chart for fraction defective and to check the control of the process for a given set of plastic balls.
8. To draw a C- chart for a given set of metal discs and to check the control of the process by taking each disk with 10 holes of each 6 mm size as one unit.
9. To show that the sample means from a rectangular universe follow a normal distribution.

10. To draw multiple activity chart or man-machine chart for the subject of toasting 3 slices of bread in one electric double compartment toaster.
11. To draw $\bar{X}$ and R charts and to determine the process capability from the measurement of large diameter of a given set of stepped pins.
12. Measure the skill and dexterity in the moment of wrist and fingers using pin board.

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.