SVKM's Narsee Monjee Institute of Management Studies

Mukesh Patel School of Technology Management & Engineering

Program: B. Tech. Integrated (Mechanical)				**Semester:** III	
Course/Module: Manufacturing Processes - I				**Module Code:** BTIME03001	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks- 100 in Question Paper)**
3	0	0	3	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Workshop Practice – I & II (BTIME01007 & BTIME02004)

Objectives:

- To introduce different manufacturing processes like casting, welding, forging, rolling, extrusion, drawing, machining etc.
- To impart knowledge of industrial applications of various processes, equipment used in manufacturing.

Outcomes :

After completion of the course, students would be able to:

- Select appropriate process of casting based on design of component.
- Classify and explain the different metal forming processes.
- Recommend suitable types of joining processes with reference to product design.
- Understand the operations and construction of lathe.
- Identify and eliminate different defects in manufacturing processes.

Detailed Syllabus: (per session plan)		
Unit	**Description**	**Duration**
1	**Metal Casting:** **Pattern Making**: Types of patterns, allowances, colour coding; Foundry practices **Moulding sands**: types, properties, preparation and testing of sand. Core boxes, core making, types of cores and their manufacturing; Gating system – runner and risers; **Moulding processes**: shell moulding, CO_2 moulding, investment casting, die casting, centrifugal casting and continuous casting; Study of various defects in castings.	10
2	**Forming processes:** Cold and hot working **Rolling:** Principle and mechanism, types of rolling and their applications, defects in rolling. **Forging:** Classification of forging processes, basic categories and methods of forging, heat treatment of forged parts. **Extrusion**: Hot And cold Extrusion, Equipment, Estimation of extrusion force, defects In extruded parts; wire and tube **Drawing**: Metal Stamping And Forming, blanking, piercing, bending, deep drawing, roll forming, shear forming and flow Forming.	14

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	Press tools: Different type of presses and their working, strip layout, Progressive die, Compound and combination dies	
3	**Joining processes:** Surface preparation for joining and various types of joints; classification of welding processes - arc Welding, submerged arc welding, gas and metal arc welding, tungsten arc welding – theory and their applications; electron beam welding, ultrasonic welding, laser beam welding, resistance welding, spot, seam and projection welding processes, welding of various metals, characteristics of good weld, weld defects and weldability of metals; soldering, brazing and their applications; adhesives for joining.	12
4	**Lathe:** Introduction, Construction, working and operations performed on lathe, attachments and accessories, types of cutting tools, cutting parameters such as spindle speed, feed and depth of cut, Capstan and Turret lathe, automatic lathes and their construction.	09
	Total	**45**

Text Books:

1. Rao P. N. (2008), "Manufacturing Technology-Vol I", *Tata McGraw Hill.*
2. Kalpakjian S. and Schmid S. R. (2002), "Manufacturing Engineering and Technology", 4th Edition, *Pearson.*

Reference Books:

1. Chapman W. A. J. (2011), "Work Shop Technology- Vol I, II, III", *ELBS Publishers.*
2. Lal G. K. (2010), "Fundamentals of Manufacturing Processes", *Alfa Science International.*
3. Kou Sindo (2003), "Welding Metallurgy", *Wiley Inter science.*

Any other information: NIL

Details of Internal Continuous Assessment (ICA):
Test Marks: 20
Term Work Marks: 30

Details of Term work:
Term work should consist of the following:

1. Assignments based on the above syllabus (Min. 4).
2. Visit to foundry/ fabrication unit.
3. Viva Voce, Quizzes, Presentations based on syllabus.

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Program: B. Tech. Integrated (Mechanical)				**Semester:** III	
Course/Module: Engineering Thermodynamics				**Module Code:** BTIME03002	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks- 100 in Question Paper)**
3	0	2	4	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Mathematics-I & II (BTIAB01002 and BTIME02001)

Objectives:

- Introduce basics of thermodynamics and concepts of work and heat transfer.
- Impart knowledge of laws of thermodynamics and their applications
- To provide understanding of properties and behavior of pure substances and gas mixtures.

Outcomes:

After completion of the course, students would be able to:

- Understand the fundamental concepts of engineering thermodynamics.
- Analyze closed systems, steady and unsteady flow systems and laws of thermodynamics and available energy.
- Determine the properties of gases and mixtures of gases and properties of pure substances.
- Use steam tables and charts for property evaluation.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction:** Definition, and basic concepts of engineering thermodynamics; description of matter – macroscopic description and microscopic description; thermodynamic system, surroundings and the system boundary; thermodynamic properties, processes and cycles; homogeneous and heterogeneous systems; thermodynamic equilibrium; quasi-static process; pure-substance; concepts of continuum. **Pressure, Volume and Temperature:** definition of pressure, volume and temperature and their measurements; Thermal equilibrium; Zeroth law of thermodynamics; – thermometric property, scale of temperature, reference points, comparison of different types of thermometers; ideal gas; gas thermometers; ideal gas temperature; Celsius temperature scale; illustrative examples. **Work and Heat Transfer:** Mechanics definition of work and its limitations; thermodynamics definition of work; classification of work; general expression for mechanical displacement work; expressions for various forms of work; net work transfer between a system and its surroundings; definition of heat transfer; characteristics of heat transfer.	08
2	**First Law of Thermodynamics:** Definition of the first law; Application of first law for a closed system undergoing a cyclic and	08

	non-cyclic process; different forms of stored energy; pure substance; specific heats, Application of first law for an isolated system; first law equation for steady and unsteady flow open systems.	
3	**Second Law of Thermodynamics:** Limitations of first law; Kelvin-Planck statement of second law; Clausius statement of second law; equivalence between the two statements; reversibility and irreversibility- definition of a reversible heat engine; corollaries of second law of thermodynamics; reversibility and irreversibility as applied to a non-cyclic process; Statement of Third Law of Thermodynamics and its importance	08
4	**Entropy:** Introduction; Clausius inequality (or Clausius theorem); Entropy as a property of a system; Temperature – entropy plot and its usefulness in analyzing thermodynamic processes; entropy change for an irreversible process; principle of increase of entropy ; Carnot cycle, entropy generation in closed and open systems; Tds relations and their significance(first and second law combined), Isentropic process.	06
5	**Available Energy, Availability and Irreversibility:** classification of energy- high grade energy and low grade energy; concepts of available energy, unavailable energy, availability and its application to closed and open systems; second law efficiency	05
6	**Properties of Gases and Gas Mixtures:** Avogadro's law; equation of state for a gas; ideal gas; equations of state; properties of mixtures of gases- Dalton's law and Gibb's law, internal energy, enthalpy , specific heats and entropy of a mixture of gases	04
7	**Properties of Pure Substances:** p-v and p-T diagrams for a pure substance; T-s and h-s diagrams for a pure substance; quality/dryness fraction; steam tables and Mollier chart, calculation of thermodynamic properties such as specific volume, internal energy, enthalpy, entropy and steam quality for various processes using steam tables and Mollier chart.	06
	Total	45

Text Books:

1. P. K. Nag (2008), "Engineering Thermodynamics", *Tata McGraw Hill.*
2. M. J. Moran, H. N. Shapiro, D. D. Boettner, M. B. Bailey (2011), "Fundamentals of Engineering Thermodynamics", 7th Edition, *John Wiley and Sons.*

Reference Books:

1. Y. Cengel and M. Boles (2008), "Thermodynamics -An Engineering Approach", *Tata McGraw Hill.*
2. R. E. Sonntag, C. Borgnakke and G. J. V. Wylen (2005), "Fundamentals of Thermodynamics", 6th Edition, *Wiley India.*

Any other information: NIL

Details of Internal Continuous Assessment (ICA):
Test Marks: 20
Term Work Marks: 30

Details of Term work:
Term work should consist of the following:

1. Assignments covering syllabus (Min. 3).
2. Viva examination on fundamental concepts in the syllabus.

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Mukesh Patel School of Technology Management & Engineering

Program: B. Tech. Integrated (Mechanical)				**Semester:** III	
Course/Module: Machine Shop - I				**Module Code:** BTIME03003	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours Per Week	**Practical Hours Per Week**	**Tutorials Hours Per Week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks-50)**	**Term End Examinations (TEE) Theory (-----)**
0	2	0	1	Marks Scaled to 50	-

Pre-requisite: Workshop Practice-I (BTIAB01007)

Objectives:

- To train the students on turning operation such as plain, taper turning, facing, thread cutting, grooving, knurling and wire drawing die on metals

Outcomes :

After completion of the course, students would be able to:

- Perform different operations on lathe like plain, taper turning, facing, grooving and knurling.
- Perform different operation on lathe like drilling, boring, counter boring, internal taper turning for making of wire drawing die.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	Two jobs on lathe performing plain and taper turning.	08
2	Two jobs on precision turning, taper turning and screw cutting.	10
3	Assembly of Two pieces of Wire drawing die by using operations like drilling, boring, counter boring, internal taper turning.	12
	Total	**30**

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Program: B. Tech. Integrated (Mechanical)				**Semester:** III	
Course/Module: Engineering Mathematics-I				**Module Code:** BTIME03004	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks- 100 in Question Paper)**
3	0	2	4	Marks Scaled to 50	Marks Scaled to 50

Objectives:

- To impart knowledge of complex numbers and its applications to solve Engineering problems.
- To provide an understanding of principles of vector algebra, single variable and multivariable calculus.

Outcomes:

After completion of the course, students would be able to :

- Understand the concepts of complex numbers, hyperbolic functions, Mean value theorems and vector products to solve Engineering problems.
- Express functions in series using Taylor's and Maclaurin's expansions, and evaluate limits of indeterminate forms using L' Höspital's Rule.
- Find partial derivatives of functions and carry out the knowledge to error and approximations, maxima and minima.
- Apply the concepts such as gradient, directional derivative, curl and divergence to solve real life problems.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1.	**Complex Numbers:** Introduction to complex numbers, modulus and amplitude of a complex number, Argand's diagram, cartesian, polar and exponential forms of a complex number. **Algebra of complex numbers:** equality, addition, subtraction, multiplication and division. De-Moivre's theorem, Roots of complex numbers, Euler's form of circular functions, Hyperbolic functions, relation between circular and hyperbolic functions.	12
2.	**Mean value theorems, Series expansion and Indeterminate forms:** Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem. Taylor's formula, Maclaurin's series. **Indeterminate forms:** $\frac{0}{0}, \frac{\infty}{\infty}, 0\times\infty, \infty-\infty, 0^0, \infty^0, 1^\infty$ by L'Höspital's rule.	10
3.	**Partial Derivatives and its applications:** Partial Derivatives of two and three variable functions, Partial derivative of composite function, Homogeneous functions in two or	13

	three variables, Euler's theorem, error and approximations, Maxima and Minima in 2 variables by second derivative test.	
4.	**Vectors:** Scalar and vector triple products, Product of four vectors, curves in space, Differentiation of a vector function of a single scalar variable, Theorems on derivatives, concept of tangent vector, scalar and vector point functions, gradient, directional derivative, Curl and Divergence, Irrotational and Solenoidal Fields.	10
	Total	**45**

Text Book:

1. Erwin Kreyszig (2010), "Advanced Engineering Mathematics", *Wiley Eastern Ltd, 10th edition.*

Reference Books:

1. Andreescu Titu, Andrica Dorin (2014), Complex Numbers from A to ... Z, *Birkhäuser Basel Publishers, 2nd edition.*
2. Thomas, Calculus (2014), *Pearson Education, 7th edition.*
3. Howard Anton (2012), "Calculus", *Wiley, 10th edition.*
4. B. V. Ramana (2010), "Higher Engineering Mathematics", *Tata McGraw Hill, 1st edition.*
5. Alan Jeffrey (2003), Handbook of Mathematical Formulas and Integrals, *Academic Press, 3rd edition.*

Any other information: NIL

Details of Internal Continuous Assessment (ICA):
Test Marks: 20
Term Work Marks: 30

Details of Term work:
As per institute norms.

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Program: B. Tech. Integrated (Mechanical				**Semester:** III	
Course/Module: Engineering Chemistry				**Module Code:** BTIME03005	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100 in Question Paper)**
2	2	0	3	Marks Scaled to 50	Marks Scaled to 50

Objectives

1. To introduce basic principles of chemistry such as functional group identification, properties of solutions, and reaction stoichiometry.
2. To familiarize the concepts and applications of fuels, polymers, and e-waste management.

Course Outcomes:

After completion of the course, students would be able to:

1. Identify different functional groups of compounds and various organic reactions associated with it.
2. Identify the importance of various classes of polymers and applications in daily life.
3. Classify different types of fuels and lubricants based on their properties and applications;
4. Recognize the importance of e-waste management with respect to environment and health hazards and solve numerical problems based on atom economy and distinguish the various formula applied to different types of solutions; interpret reaction stoichiometry and solve numerical problems.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1.	**Organic Reactions:** Reactions of functional groups: those containing oxygen (-COOH, -OH, -CHO, -C=O); Nucleophilic substitution reaction, Elimination reaction Organic Name Reactions E.g. Aldol & related reactions.	06
2.	**Solutions and Stoichiometry:** Types of solutions and its characteristics, properties of aqueous solutions, different units for expressing concentration of solutions (ppm, ppb, normality, molarity, molality, mole fraction of solute, mass fraction of solute and solvent), empirical and molecular formula from elemental composition, numerical based on empirical formula, normality, molarity, molality molarity.	06
3.	**Fuels & Combustion:** Definition, Classification, characteristics. Calorific Value-Theoretical & Experimental (Bomb calorimeter). **Solid Fuels**: Coal, proximate and ultimate analysis, Numerical based on analysis of coal. (Dulong formula) and bomb calorimetry. **Liquid fuels**: Mining of Petroleum, Cracking, Reforming, Knocking in IC engines, anti-knocking agents (TEL and MTBE),	06

4.	**Lubricants:** Definition, Mechanism of lubrication, Properties- viscosity, viscosity index, flash & fire, cloud & pour points, oiliness, saponification & acid value (numericals based on saponification and acid value)	04
5.	**Polymers:** Introduction and definition of important terms – monomer, polymer, polymerization, degree of polymerization, tacticity, and melting-glass transition temperature. Some commercially important polymers (PP, PVC). **Plastics**: Thermosetting & Thermoplastics, Compounding of plastics, Preparation, properties and applications of commercial plastics (Rubber, Phenol formaldehyde resin).	05
6.	**Environmental Aspects of Chemistry:** **i) Green Chemistry:** Principles of Green Chemistry with examples (Numerical Problems on Atom economy) **ii) E-waste management:** Definition, classification and management of e-waste.	03
	Total	30

Text Books:

1. Abhijit Mallick; Chemistry for Engineers, Viva books, 2nd Edition 2017.
2. Palanna.O.G., Engineering Chemistry, Tata McGraw Hill Education. Pvt. Ltd, 2nd Edition 2017.
3. Samir Sarkar; Fuels & Combustion, Orient Longman Pvt. Ltd 3rd Edition 2009.

Reference Books:

1. R.T. Morrison & R. N. Boyd, Organic Chemistry, Prentice Hall, 8th Edition 2016.
2. Johrie. R.; E-waste, TERI Press, 2009.
3. Paul C. Hiemenz & Timothy P. Lodge; Polymer Chemistry, CRC Press, 2nd Edition 2007.

Any other information:

Details of Internal Continuous Assessment (ICA)
Test Marks: 20
Term Work Marks: 30

Details of Term work:
1. Minimum Eight Lab experiments to be taken.
2. Unit wise assignments to be taken.
3. Presentation/Viva-voce/Quiz to be conducted.

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SVKM's Narsee Monjee Institute of Management Studies

Mukesh Patel School of Technology Management & Engineering

Program: B. Tech. Integrated (Mechanical)				**Semester:** III	
Course/Module: Constitution of India				**Module Code:** BTIME03006	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100 in Question Paper)**
2	0	0	0	Marks Scaled to 50	---

Objective:

- To understand the basic aspects of the constitution of India, the evolution, the directive principle & important provisions.
- To understand the implications of important constitutional provision on Business and Professionals.

Outcomes:

After completion of the course, students would be able to:

- Learn basic aspects of constitution of India.
- Apply Constitutional provision on Business and their Professionals.

Detailed Syllabus: (per session plan)

Unit	**Description**	**Duration**
1.	The Constitution, its evolution and Preamble to the Constitution.	04
2.	Fundamental rights and duties, exceptions with examples, individual responsibilities and duties, application to business.	10
3.	Directive principles of State Policy, its emphasis and its impact as related to business.	04
4.	Indian Judiciary and LokAdalats.	06
5.	Emergency Provisions under Article 352 – 360.	04
6.	Voting behaviour in India and present political scene. Responsibility of Business in relation to the Constitution.	02
	Total	**30**

Text Books:

1. Durga Das Basu (2009), "Indian Constitution", *20th Edition.*

Reference Books:

1. N. A. Palkhiwala (2009), "We the People".
2. Justice Hidayatullah (2009), "Indian Constitution".

Any other information:

Details of Internal Continuous Assessment (ICA)

Test Marks: 20

Term Work Marks: 30

Details of Term work:

1. Assignments / Case studies
2. Two class tests.

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Program: B.Tech. Integrated (Mechanical)				**Semester :** III	
Course/Module : Engineering Mechanics				**Module Code** : BTIME03007	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100 in Question Paper)**
3	0	2	4	Marks Scaled to 50	Marks Scaled to 50

Objectives:

- To develop thorough understanding of moment of inertia
- To know the concept of pin jointed frames
- To get acquainted with the dynamic system in equilibrium and the motion characteristics of particles
- To study the forces developed on bodies in motion

Outcomes:

After successful completion of this course, students should be able to

- Determine moment of inertia for plane areas
- Analyse pin jointed frames
- Evaluate the velocity, acceleration and displacement of a moving body
- Analyse the forces developed on the moving body

Detailed Syllabus:

Unit	Description	Duration
1.	**Moment of inertia of plane areas:** Moment of inertia of plane areas, parallel axis theorem. Introduction to polar moment of inertia, product of inertia and mass moment of inertia.	04
2.	**Analysis of pin jointed plane frames:** Perfect truss, method of joints, and method of section.	06
3.	**Forces in space:** Rectangular components of forces in space, resultant of concurrent forces, moment of a forces about a point and a given axis, resultant of general force system, Equilibrium of a particle in space.	07
4.	**Principle of virtual work:** Application to determine the reactions of determinate beams with/ without internal hinges	04
5.	**Kinematics of particle:** Motion along plane curved path, tangential and normal component of acceleration, simple harmonic motion. **Kinematics of rigid bodies:** Translation, pure rotation and plane motion of rigid bodies, instantaneous centre of rotation for the velocity for bodies in plane motion, link mechanisms (upto two links).	10
6.	**Kinetics of particles:** Newton's laws of motion, D'Alembert's principle, equation of dynamic equilibrium, linear motion, curvilinear motion.	08

	Kinetics of rigid bodies: D'Alembert's principle for bodies under translational motion, rotational motion about a fixed axis and plane motion Application to motion of bars, cylinders, spheres.	
7.	**Energy and momentum principles:** Work done by a force, potential and kinetic energy, power, work energy equation, principle of conservation of energy, momentum, principle of conservation of momentum, impact of solid bodies, elastic impact, semi-elastic impact and plastic impact.	06
	Total	**45**

Text Book:

1. N. H. Dubey (2014), "Engineering Mechanics", *Tata McGraw Hill*
2. R. C. Hibbler (2004), "Engineering Mechanics", *McMillan Publishers*

Reference Books:

1. F. L. Singer (1954), "Engineering Mechanics", *Harper & Raw Publication* (Classic book)
2. Beer & Johnson (2011), "Engineering Mechanics", *Tata McGraw Hill*
3. D. S. Kumar (2009), "Engineering Mechanics", *Tata McGraw Hill*
4. Macklin & Nelson (2012), "Engineering Mechanics", *Tata McGraw Hill*
5. A. K. Tayal (2008), "Engineering Mechanics", *Umesh Publication*
6. E. W. Nelson, Charles L. Best, W.G. Mclean, Merle Potter (2010), "Schaum's outlines on Engineering Mechanics -Statics", *Tata McGraw Hill*

Any other information:

Details of Internal Continuous Assessment (ICA)
Test Marks: 20
Term Work Marks: 30

Details of Term work:
Term work should consists of the following

1. Minimum eight assignments covering the prescribed syllabus.

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Program: B. Tech. Integrated (Mechanical)				**Semester:** IV	
Course/Module: Manufacturing Processes - II				**Module Code:** BTIME04001	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100 in Question Paper)**
3	0	0	3	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Manufacturing Processes - I (BTIME03001)

Objectives:

- To provide basic understanding of different material removal processes.
- To explain the mechanics of cutting with single point, multi-point and multi edge cutting tools.
- To introduce the basics of different nonconventional machining processes.

Outcomes :

After completion of the course, students would be able to:

- Analyze the metal cutting processes with tool geometry and forces of cutting.
- Understand the operations and construction of different machine tools like milling, drilling, Shaping and Grinding Machines.
- Select the appropriate types of operation based on given component design.
- Compare the different nonconventional processes according to industrial applications.
- Differentiate the various plastics processing methods according to industrial applications.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Metal cutting:** Tool Geometry, forces in single point cutting, tool wear and tool life, formation of chips and types of chips, Mechanics of orthogonal and oblique cutting, chip thickness ratio, velocity relationship in orthogonal cutting, Merchant's circle diagram, analysis of stresses and strains and work done during metal cutting, friction and thermal aspects of metal cutting, Cutting Fluids, Types of Cutting Fluids.	11
2	**Shaper and Planer:** Introduction, Construction, working and operations performed on Shapers, Planers & slotters. **Milling Machines**: Types of milling machines, tools and their geometry, various operations on milling machine, different attachments including dividing heads and work holding devices.	06
3	**Drilling Machines:** Types of machines, operations such as drilling, boring, reaming, spot facing, counter boring and sinking, tapping, drill speed and feeds. **Boring and Broaching Machine:** Classification-horizontal and vertical boring machine, types of broaching machines, advantages, limitations and applications of broaching.	08

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4	**Abrasive Machining Processes:** Mechanics of grinding, types and operations of grinding machines, Centreless grinding, Grinding wheel specifications and its selection, Truing and dressing of wheels, Super finishing processes such as lapping and honing. Abrasive jet machining (AJM) and Abrasive water jet machining (AWJM).	08
5	**Nonconventional Machining processes**: Mechanical, chemical and thermal energy based nonconventional machining processes, Electric discharge machining (EDM), Electro-chemical machining (ECM), Electro-chemical grinding (ECG), applications of different Nonconventional machining processes, Laser Beam machining and allied process.	06
6	**Processing of Plastics:** General aspects, methods of processing of plastics, compression moulding, transfer moulding, injection moulding, roto-moulding, blow moulding, thermoforming, Joining of thermoplastics, rules for design of plastic parts.	06
	Total	**45**

Text Books:

1. Rao P. N. (2008), "Manufacturing Technology- Vol II", *Tata McGraw Hill.*
2. Sharma P. C. (2008), "A Text Book of Production Engineering", *S Chand.*
3. Kalpakjian S. and Schmid S. R. (2002), "Manufacturing Engineering and Technology", 4th Edition, *Pearson.*

Reference Books:

1. Chapman W. A. J. (2005), "Workshop Technology-Vol I, II, and III", *ELBS Publishers.*
2. Chatopadhyaya A. B (2011), "Machining and Machine Tools", *Wiley India.*
3. Lal G. K. and Choudhury S.K. (2005), "Fundamentals of Manufacturing Processes", *Alpha Science International.*

Any other information:

Details of Internal Continuous Assessment (ICA)
Test Marks: 20
Term Work Marks: 30

Details of Term work:
Term work should consists of the following

1. Assignments based on the above syllabus (Min. 4).
2. Visit to tool room of manufacturing plant.
3. Viva Voce, Quizzes, Presentations based on syllabus.

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Program : B. Tech Integrated (Mechanical)				**Semester :** IV	
Course/Module: Machine Drawing and Computer Graphics				**Module Code:** BTIME04002	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks-50)**	**Term End Examinations (TEE) (Marks -100 in Question Paper)**
2	4	0	4	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Mathematics-I (BTIME01002), Mathematics-II (BTIME02001), Engineering Drawing-I (BTIME01006), Engineering Drawing-II (BTIME02006).

Objectives:

- To introduce the concepts of detail drawing of mechanical components and assemblies.
- To motivate the students to understand the importance of limit, fits and tolerances in Mechanical Systems.
- To impart the knowledge of jig and Fixtures.

Outcomes:

After completion of the course, students would be able to:

- Draw assembly and details of various mechanical components.
- Specify the tolerances, limits and fits and surface finish in assembly and details.
- Use drafting packages proficiently.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Intersection of Solids and Development of Surfaces:** Curves of intersection of the surfaces of the solid in the following cases (a) Prism with Prism, Cylinder with Cylinder, Prism with Cylinder When (i) The axes are at 90^0 and intersecting (ii) The axes are at 90^0 and offset (b) Cylinder with cones When axis of cylinder is parallel to both reference planes and cone resting on base on HP and with axis intersecting and offset from axis of cylinder.	06
2	**Conventional Representation:** **(a)** Materials C.I., M.S., Brass, Bronze, Aluminum, Wood, Glass, Concrete and Rubber **(b)** Long and short break in pipe, rod and shaft **(c)** Ball and roller bearing, pipe joints, valves **(d)** Various sections- Half, Removed, Revolved, offset, Partial and Aligned sections. **(e)** Springs with square and flat ends, Gears, Sprocket wheels **(f)** Countersunk and Counter bore	06

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	(g) Tapers	
3	**Presentation of Limits, Fits and Tolerances:** (a) Characteristics of surface roughness- Indication of machining symbols showing direction of lay, roughness grades, machining allowances, manufacturing methods. (b) Introduction of ISO system of tolerances, dimensional tolerances, elements of interchangeable system, hole and shaft based system, limits, fits & allowances. Selection of fits. (c) Geometrical tolerances, tolerances of form and position and its geometrical representation. (d) General welding symbols, sectional representation and symbols used in engineering practices.	06
4	**Details to Assembly and Assembly to Details of the following** (a) Introduction (b) Couplings- Universal coupling & Oldham's coupling (c) Bearing- Foot Step Bearing & Plummer Block (d) Lathe tool Post, Lathe tail stock (e) Machine vice & Pipe Vice (f) Screw Jack (g) Valves: V Gate valve, globe valve, non-return valve. (h) Drill Jig and fixture (i) Piston and connecting rod (j) Joints: Knuckle Joints, Cotter Joints	12
	Total	**30**

Text Books:

1. N. D. Bhatt and V. M. Panchal (2010), "Machine Drawing", 45th Edition, *Charotar Publishing House.*
2. P. S. Gill (2010), "Machine Drawing", *S. K. Kataria and Sons.*

Reference Books:

1. Sideshvar and Shashtri (2001), "Machine Drawing", 1st Edition, *Tata McGraw Hill.*
2. Narayana and V. Reddy (2010), "Production Drawing", *New Age International.*
3. General principles of presentation of technical drawing IS 10714-2006.
4. Guide for selection of fits IS: 2709-1982

Any other information:

Details of Internal Continuous Assessment (ICA)
Test Marks: 20
Term Work Marks: 30

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Details of Term work:

1. Total five A2 size drawing sheets.(one on Intersection of Solids. Conventional Representation and three sheets on Assembly to details and Details to assembly showing Limits, Fits and tolerances on it.)
2. Computer drafted A3 size drawing sheets consisting problems on Details to Assembly and Assembly to Details.

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Program: B. Tech. Integrated (Mechanical)				**Semester:** IV	
Course/Module: Strength of Materials				**Module Code:** BTIME04003	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100 in Question Paper)**
3	0	2	4	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Engineering Mechanics (BTIME03007)

Objectives:

- To impart knowledge of the deformable bodies subjected to different types of loads
- To determine the failure criteria of a body subjected to various stresses
- To understand the concepts of deformations.
- To identify the different tests to be performed on materials

Outcomes:

After completion of the course, students would be able to:

- Calculate the resultant stresses induced in the components.
- Analyse the failures based on the stresses generated in the components.
- Evaluate the deformations of various determinate beams.
- Relate various failures based on the testing of materials.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Stress and Strain:** Strain, modulus of elasticity, modulus of rigidity, bulk modulus, yield stress, ultimate stress, factor of safety, shear stress, Poisson's ratio, analysis of members made of composite materials.	06
2	**Shear Force and Bending Moment:** Axial force, shear force and bending moment diagrams for statically determinate beams for different types of loading.	07
3	**Simple Theory of Bending**: Flexure formula for straight beams, simple problems involving application of flexure formula, section modulus, moment of resistance of a section.	06
4	**Shear Stress in Beams:** Distribution of shear stress across plane sections used commonly for structural purposes.	04
5	**Simple Theory of Torsion:** Torsion of circular shafts – solid and hollow, stresses in power transmission shafts (including shafts in series and parallel).	03
6	**Bending Moment Combined with Axial Loads:** Application to members subjected to eccentric loads, core of a section, problems on chimneys involving lateral loads.	04
7	**Principal Stresses:** General equations for transformation of stress, stress on an oblique plane of a member subjected to General two directional stress systems. Principal planes and principal stresses, maximum shear stress Mohr's circle concept.	06

8	**Deflection of Beams:** Deflection of cantilevers, simply supported and overhanging beams using double integration and Macaulay's methods for different types of loading.	05
9	**Thin Shells:** Stresses in thin cylindrical and spherical shells subjected to internal pressure. Efficiency of Rivetted Joints.	04
	Total	**45**

Text Books:

1. James M. Gere, Barry J. Goodno (2012), "Mechanics of Materials – SI Edition", *Cengage Learning*.
2. Ferdinand P. Beer, .E Russell Johnson Jr. John T. DeWolf (2008), "Mechanics of Materials", 3rd Edition, *Tata McGraw Hill*.

Reference Books:

1. Andrew Pytel, Jaan Kiusalaas (2011), "Mechanics of Materials", 2nd Edition, *Cengage Learning*.

Any other information:

Details of Internal Continuous Assessment (ICA)
Test Marks: 20
Term Work Marks: 30

Details of Term work:

1. Minimum 8 assignments covering the prescribed syllabus

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SVKM's Narsee Monjee Institute of Management Studies

Mukesh Patel School of Technology Management & Engineering

Program: B. Tech. Integrated (Mechanical)				**Semester:** IV	
Course/Module: Machine Shop – II				**Module Code:** BTIME04004	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100 in Question Paper)**
0	2	0	1	Marks Scaled to 50	---

Pre-requisite: Machine Shop - I (BTIME03003)

Objectives:

- To practices machining of flat surfaces on shaping and grinding machines.
- To practices milling, boring and screw cutting operations (both on internal and external surfaces).

Outcomes :

After completion of the course, students would be able to:

- Understand the making of composite job having more than two parts and different type of machining processes.
- Understand difference between metal machining and composite machining.
- Understand different operations like milling, shaping, grinding, boring etc.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	One composite job consisting minimum four parts employing operations on lathe, precision turning, external and internal threading, boring.	15
2	Shaping, milling, grinding & Knurling operations on composite job.	12
3	Demo on machining of Glass Fiber Reinforcement Plastic (GFRP) composite material, Drilling and edge milling operation are to be study. (Any of the commercial available GFRP/Epoxy plates are to be used).	03
	Total	**30**

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Program: B. Tech. Integrated (Mechanical)				**Semester:** IV	
Course/Module: Engineering Mathematics-II				**Module Code:** BTIME04005	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100 in Question Paper)**
3	0	2	4	Marks Scaled to 50	Marks Scaled to 50

Objectives:

- To provide an understanding of Matrices and differential equations in technical subjects.
- To impart knowledge of Beta & Gamma functions and double integrals, its applications to solve engineering problems.

Outcomes:

After completion of the course, students would be able to :

- Solve system of linear equations
- Evaluate problems using Beta and Gamma functions
- Analyse suitable method to solve differential equations
- Relate the concepts of double integral to solve engineering problems.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1.	**Matrices:** Rank of a matrix, Rank by Normal form and Echelon form, Reduction of a matrix A to normal form PAQ, Linear dependence and independence of rows and columns of a matrix over real field. **Applications:** Solving system of linear homogeneous and non-homogeneous equations using Cramer's rule, matrix inversion method, reduction to echelon form.	12
2.	**Beta and Gamma functions**: Definition of Beta and Gamma functions and their properties; Relation between Beta and Gamma functions; Duplication formula.	08
3.	**Ordinary Differential Equations**: Definition of differential equation, order and degree of differential equation, formulation of differential equation. **Solution of differential equation of first order and first degree:** Variable separable method, reducible to variable separable method, Homogeneous differential equation, reducible to homogeneous differential equation, exact differential equation and those which can be reduced to exact form using integrating factor (four rules), Linear differential equations, Bernoulli's differential equation. **Solution of Linear differential equations of higher order with constant coefficients:** Complementary functions, Particular integrals of the differential equations of the type $f(D)y = X$	15

	where $X = e^{ax}, \sin(ax+b), \cos(ax+b), x^m, e^{ax}V(x), xV(x)$. Applications of differential equations in modelling: First-order Equations, Free Mechanical Oscillations, Forced Mechanical Oscillations.	
4.	**Double Integration:** Double integration in cartesian and polar co-ordinates, evaluation of integrals over a given region, change of order of integration, change of co-ordinate system, application of double integration to compute area, mass of a lamina and volume.	10
	Total	**45**

Text Books:

1. Robert Wrede (2010), Murray Spiegel, *Schaum's Outline of Advanced Calculus, Third Edition.*
2. B. S. Grewal (2013), "Higher Engineering Mathematics", *Khanna Publishers.*

Reference Books:

1. Erwin Kreyszig (2010), "Advanced Engineering Mathematics", *Wiley Eastern Ltd, 10th edition.*
2. Howard Anton (2012), "Calculus", *Wiley, 10th edition.*
3. G. Birkhoff and G. C. Rota, Ordinary Differential Equations (2003), *4th Edition, Wiley Singapore Edition.*
4. Alan Jeffrey (2003), Handbook of Mathematical Formulas and Integrals, *Academic Press, 3rd edition.*

Any other information:

Details of Internal Continuous Assessment (ICA)
Test Marks: 20
Term Work Marks: 30

Details of Term work:
As per institute norms.

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Program: B. Tech. Integrated (Mechanical)				**Semester:** IV	
Course/Module: Engineering Physics				**Module Code:** BTIME04006	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours Per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100 in Question Paper)**
2	2	0	3	Marks Scaled to 50	Marks Scaled to 50

Objectives

- To enable the students understand the basic principles of physics, making them meet the needs of engineering and technology.

Outcomes

After completion of the course, students would be able to :

- Apply the concept of interference, diffraction in various engineering applications.
- Understand the quantization effect in reduced dimensional materials and their consequences.
- Implement the concepts of clean energy for power generation.
- Illustrate the usage of nanomaterial in various applications.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1.	**Optics:** Interference: Analytical treatment of interference. Interference in thin film in reflected system. Wedge shaped film. Newton's rings and applications. Diffraction: Fraunhoffer's diffraction at single slit, double slits, N Parallel slits (multiple slits). Diffraction grating, resolving power of grating, dispersive power of grating.	08
2.	**Quantum physics:** The origin of quantum theory, Blackbody radiation, Wein's law, Rayleigh- Jeans Law, Stefen's law, Plank's theory, dual nature of radiation. Wave nature of Matter: De Broglie's hypothesis, Davisson-Germer Experiment, the double slit experiment with particles, the need for a wave function, Born's interpretation of the wave function. Wave Packets and Uncertainty Principle: General statement of Heisenberg's Uncertainty Principle, Energy-Time and Position-momentum uncertainty relation and its applications	08
3.	**Energy technology :** Need for clean energy, different methods for obtaining clean energy viz. nuclear energy (including basics of nuclear physics like fission and fusion etc.) solar cells (including conventional and Nano material based solar cells), hydrogen fuels and wind mills. Advantages and limitations of each method.	06

4.	**Introduction to Nanotechnology:** Definition of nanotechnology, quantum confinement effect [how the material properties differ as the size is reduced: Coloumb Blockade, Surface plasmon resonance, some basic Nano materials like carbon nanotubes, graphene, quantum dots, applications of nanotechnology (scratch resistance coatings, clothing, antimicrobial applications, drug delivery, IC technology), Nano- toxicity (basic idea). Scanning and Transmission electron microscopes, Scanning Tunneling Microscope, Atomic Force Microscope.	08
	Total	**30**

Text Books:

1. Jenkins and White (2013), Optics, *MC Graw Hill.*
2. Arther Beiser (2009), Concept of Modern Physics, *Tata McGraw Hill, 6th edition.*

Reference Books:

1. Halliday and Resnick (2014), Fundamentals of Physics, *Wiley India, 10th edition.*
2. L. I. Schiff (1968), Quantum Physics, *McGraw Hills.*
3. V. V. N. Kishore (2009), Renewable Energy Engineering and Technology – A Knowledge Compendium, *TERI Press.*
4. Sulabha K. Kulkarni (2011), Nanotechnology: Principles and Practices, *Springer.*
5. Richard P. Feynman (2011), Feynman lectures on physics, *The New Millennium Edition.*
6. Dattu R Joshi (2010), Engineering Physics, *Tata McGraw Hill, 1st Edition.*

Any other information:

Details of Internal Continuous Assessment (ICA)
Test Marks: 20
Term Work Marks: 30

Details of Term work:
As per Institute norms.

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Program: B. Tech. Integrated (Mechanical)				**Semester:** IV	
Course/Module: Numerical Techniques				**Module Code:** BTIME04007	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours Per week	**Practical Hours Per week**	**Tutorial Hours Per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100 in Question Paper)**
3	0	2	4	Marks Scaled to 50	Marks Scaled to 50

Objectives:

- To bring awareness of various numerical techniques to solve Engineering problems.

Outcomes:

After completion of the course, students would be able to :

- Analyse error in numerical data.
- Solve algebraic, transcendental and system of linear equations using different numerical techniques.
- Understand the concept of interpolation and regression.
- Apply the techniques learnt in numerical differentiation and integration to solve engineering problems.
- Evaluate ordinary differential equation numerically.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1.	**Introduction to Numerical Computing:** Introduction, Types of Errors: Absolute error, Relative error, Percentage error, Round-off error, Truncation error.	02
2.	**Roots of Equations:** Bisection Method, False Position Method, Newton-Raphson Method, Secant Method, Convergence of Numerical Methods.	10
3.	**Systems of Linear Algebraic Equations:** Gaussian Elimination Method, Gauss Jordan Method, Gauss Seidel Method, Jacobi Method.	06
4.	**Interpolation:** Finite Differences, Forward Differences, Backward Differences, Newton's Forward Interpolation, Newton's Backward Interpolation, Lagrange's Interpolation. Application of this technique to estimate data type such as income, distance, production etc.	07
5.	**Curve Fitting:** Method of Least Square to fit the straight line and the parabola.	03
6.	**Numerical differentiation & Integration:** Derivatives using Forward and Backward difference formula, Trapezoidal Rule for Numerical Integration, Simpson's 1/3 Rule, Simpson's 3/8 Rule. Application to estimate the distance covered in given time and volume of a solid.	09

7.	**Solution to Ordinary differential equations:** Picard's method, Taylor series method, Euler's method, Fourth-Order Runge-Kutta method.	08
	Total	**45**

Text Books:

1. E. Balagurusamy (2008), Numerical Methods, *Tata-Mc Graw Hill.*

Reference Books:

1. S. S. Sastry (2007), Introductory methods of Numerical Analysis, *PHI, 5th edition.*
2. B. S. Grewal (2010), Numerical Methods in Engineering & Science with Programs in C & C+ +, *Khanna Publishers.*
3. John Heinbockel (2004), Numerical Methods for Scientific Computing, *Trafford Publishing.*

Any other information:

Details of Internal Continuous Assessment (ICA)
Test Marks: 20
Term Work Marks: 30

Details of Term work:
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SVKM's Narsee Monjee Institute of Management Studies
Mukesh Patel School of Technology Management & Engineering

Program: B. Tech. Integrated (Mechanical)				**Semester:** V	
Course : Theory of Machines - I				**Code:** BTIME05001	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Fundamentals of Engineering Mechanics and Engineering Mechanics (BTIME02007 and BTIME03007)

Objectives:

- To understand the basics of links, mechanisms and machines.
- To provide knowledge of motion analysis of mechanisms.

Outcomes :

After completion of the course, students would be able to:

- Understand classification of kinetics and kinematics based on relative motion and inversion of chains.
- Locate instantaneous centre for finding of velocity of each link.
- Calculate the velocity and acceleration of given mechanisms graphically and analytically by using relative method.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Kinematics:** Basics (Mechanism and Machines, Rigid and resistant body, Link), Classification Kinematics pairs (Lower pairs and higher pairs, Form closed pairs and force closed pairs), Based on relative motion permitted such as revolute, prismatic, cam, helical Globular. Grubler's criterion, constraint, Unconstrained based on Grubler's criteria. Limitations of Grubler's Criteria. Inversion of chain: mechanisms, quick return mechanism, applications. Four bar chain, Single slider crank chain, Double slider crank chain.	12
2	**Special Mechanisms**: Straight line generating Mechanisms: Paucellier's and Hart's exact Straight Line Generating Mechanisms, Watt's Approximate straight line mechanics, Grass-hopper mechanism. Pantograph, Hook joint- single and double, Steering gear mechanisms – Ackerman, Davis.	09
2	**Velocity in Mechanism by Instantaneous Centre Method:** Introduction, Space and Body Centroid, Method for determine the velocity of a point on a link by Instantaneous Centre method, number types and location of Instantaneous Centre, Aronhold Kennedy Theorem, and Method of locating Instantaneous Centre in four bar mechanism.	08

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3	**Velocity in Mechanism by Relative Method:** Introduction, Relative velocities of two bodies moving in straight line, Motion of a link, velocity of a point on a link by relative velocity method, rubbing velocities at pin joints, mechanical advantage.	08
4	**Acceleration in Mechanism:** Velocity and Acceleration analysis - relative method in the slider crank mechanism, Corioli's components of acceleration.	08
	Total	**45**

Text Books:

1. Ratan S. S (2009), "Theory of Machines", 3rd Edition, *Tata McGrew Hill, New Delhi.*
2. Thomas Beven (2009), "Theory of Machines", 3rd Edition, *Pearson.*

Reference Books:

1. J. E. Shigley (2003)," Theory of Mechanisms and Machines", 3rd Edition, *University Press.*
2. P. L. Ballaney (2005),"Theory of Machines and Mechanisms", 24th Edition, *Khanna Publishing, New Delhi.*
3. Ghosh and Malick (1988), " Theory of Mechanisms and Machines", *East West Press Pvt. Ltd.* Classic

Term work:

1. Assignments given by the faculty based on above syllabus (Min. 3).
2. Minimum 04 experiments from the list.

List of Experiments:

1. Study of various types of mechanisms and their inversions.
2. Study of various types of lower pair mechanisms.
3. To draw velocity diagram using Instantaneous centre method.
4. To draw velocity diagram using relative velocity method.
5. To draw velocity and acceleration diagram for simple four bar mechanism.
6. To draw velocity and acceleration diagram for mechanisms involving Corioli's component.

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Program: B. Tech. Integrated (Mechanical)				**Semester:** V	
Course : Industrial Electronics				**Code:** BTIME05002	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
2	2	0	3	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Elements of Electrical Engineering (BTIME02008)

Objectives:

- The subject is primarily concerned with to provide knowledge of the wide range of power electronic converter circuits which includes AC-DC, DC-DC and DC-AC power conversion.
- This course also aims to equip the student with a basic understanding of modern power semiconductor devices, their strengths, and their switching techniques.
- The course also equips student with ability to understand and analyse the qualities of waveforms at input and output ends of these converters.

Outcomes:

After completion of the course, students would be able to:

- Understand and analyse systems used for industrial applications.
- Gain hands on experience with the operation of various power electronics systems.

Detailed Syllabus:		**Duration**
Unit	**Description**	
1	**Power Devices:** Construction, Static and dynamic characteristics and ratings of SCR, GTO, IGBT, Power Diode, DIAC, TRIAC Methods of turning on of SCR - Design of Gate triggering circuit using UJT and Commutation circuits.	08
2	**Choppers**: Commutation circuits, choppers single phase circuits: step up and step down chopper.	05
3	**Single-phase AC/DC Converter:** Circuit diagram, operation & waveforms for R and R-L loads of line frequency phase controlled rectifiers using SCR – single phase full/half controlled converters with continuous and constant current.	06
4	**Single-phase DC/ AC inverters:** Series and parallel inverters , circuit diagram, operation & waveforms for single phase inverters- series, parallel and full bridge inverter, basic circuit operation of PWM inverters Circuit diagram.	06
5	**Operational Amplifier and Timer Circuits:** Introduction and basic applications of IC 741, Monostable and Astable multi vibrator using IC 555.	05
	Total	**30**

Text Books:

1. Rashid M. (2005), "Power Electronics", *Prentice Hall of India Publication.*
2. Singh M. D. & Khanchandani K. B. (2006), "Power Electronics", 1st Edition, *Tata McGraw Hill.*
3. Gaikwad R. (2002), "Op-amp and linear integrated circuits", 4th Ed, *Prentice Hall of India*, ISBN 81 - 203 -2058 – 1

Reference Books:

1. Ned Mohan, Undeland (2003), "Robbins, Power Electronics", *John Wiley Publication.*
2. Landers (2009), "Power Electronics", *McGraw Hill.*
3. Dubey G. K. (2002), "Electrical Drives", *Narosa Press.*
4. SCR Manual (2010), "General Electric".

Term Work:

1. Experiments as per the list given below.
2. Minimum two assignments.

List of Experiments:

1. To plot V-I Characteristics of SCR.
2. To understand Step up and step down Chopper Circuit using waveforms.
3. To Study Single Phase Controlled Rectifier
4. To Study Series Inverter
5. To implement OPAMP 741 As a Inverting amplifier, non-Inverting amplifier and summing amplifier
6. To implement 555 timer - monostable and astable operation

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Program: B. Tech. Integrated (Mechanical)				**Semester:** V	
Course: Materials Engineering				**Code:** BTIME05003	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Physics-I and II (BTIME01003 and BTIME02002) and Chemistry- I and II (BTIME01004 and BTIME02003).

Objectives:

- To learn the fundamental science and engineering relevant to materials
- To introduce the concept of mechanical deformation in metals
- To impart the knowledge of various failure mechanisms in materials and the theories and design modifications to avoid them.

Outcomes:

After completion of the course, students would be able to:

- Design a process, microstructure and components to satisfy the system requirements
- Analyze the root cause of failure in different types of materials
- Select appropriate materials for various applications depending on the structural requirements
- Participate in teams carrying out new product, process development in diverse areas like aerospace, bio-medical and automobile.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Mechanical Behavior of Metals:** **Deformation:** Definition, elastic and plastic deformation and significance in design and shaping deformation in single crystal and polycrystalline materials, critical stress for deformation. **Material Testing:** Basic mechanical properties, tensile testing, hardness testing, Impact testing, non-destructive testing **Strain Hardening:** Definition and importance, dislocation theory, effect of strain hardening on engineering behavior of material, recrystallization annealing, recovery, recrystallization and grain growth.	10
2	**Failure of Metals:** **Fracture:** Definition and types, Griffth's theory of fracture, Orowan's Modification, dislocation theory of fracture, **Fatigue:** Definition and significance of cyclic stress, mechanism of fatigue and theories of fatigue failure, S-N curve and its interpretation, Notch effect, surface effect, Corrosion and thermal fatigue.	08

	Creep: Definition and significance of creep, analysis of classical creep curve, creep resistant materials	
3	**Phase Diagrams:** Concept of solidification of metals, Solidification of pure metals, solid solutions, nucleation, growth of the new phase, Solidification of alloys, progressive, directional solidification and control of solidification to obtain sound castings. Objectives and classification of phase diagram, System, phases and structural constituent of phase diagram, Coring and dendritic segregation, Gibb's phase rule, Eutectic, Peritectic and eutectoid system, Equilibrium diagrams for non –ferrous alloys, Lever rule.	06
4	**Fe-Fe_3C Equilibrium Diagram:** Importance of iron as engineering material, Allotropic forms of irons, **Fe-Fe3C diagram:** phases, reactions, and critical temperatures Solidification and microstructure of different steels, Non equilibrium cooling of steel. **Effect of Alloying Elements in Steels:** Limitation of plain carbon steels. Significance of alloying elements. Classification of tool steels and metallurgy of tool steels and special steels. **Cast irons:** White, gray and malleable cast iron, Nodular and mottled cast iron, Alloy cast iron	08
5	**Heat Treatment of Steel:** Definition and significance of heat treatment, Time temperature transformation diagrams (TTT), Continuous cooling Transformation (CCT), Equilibrium and non equilibrium transformation of austenite. **Annealing:** Principle process, properties and applications of full annealing, diffusion annealing, process Annealing and cyclic annealing. Normalizing, Hardening, tempering.	06
6	**Powder Metallurgy:** Characteristics and production of metal powders, blending and mixing, compacting, pre-sintering and sintering secondary operations	02
7	**Engineering Alloys** **Ferrous Alloys:** Classification, stainless steel, Tool Steel. **Non ferrous alloys**: Brass, bronzes (Tin, Beryllium and Silicon), Aluminium and its alloys .Copper-Nickel Alloys.	05
	Total	**45**

Text Books:

1. Callister Willam D., Jr., Adopted by Balsubramanium R. (2009), "Material science and Engineering", *Wily India (P) Ltd.*
2. Avner S. H. (2012), "Introduction to Physical Metallurgy", *Tata McGraw Hill.*

Reference Books:

1. Kodgire V. D., Kodgire S. V. (2003) "Material science and Metallurgy" *Everest Publishing House, Pune.*

2. Raghvan V. (2003), "Material Science and Engineering." *Prentice Hall of India, New Delhi.*
3. Dieter G. (1986), "Mechanical Metallurgy", *Tata McGraw Hill (classic).*

Term Work:

1. Assignments (Min. 2)
2. Practicals based on the syllabus (any 6 from the list below)

List of Experiments:

1. Flaw detection by dye penetrant test
2. Study of ultrasonic flaw detection technique
3. Study the non-destructive technique of magnetic crack inspection
4. Study of metallurgical microscope
5. Preparation of sample for microstructural evaluation
6. Study of steel microstructures
7. Measurement of hardness of a given specimen using different hardness scales
8. Study of Hardenability of steel samples

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Program: B. Tech. Integrated (Mechanical)				**Semester:** V	
Course: Fluid Mechanics				**Code:** BTIME05004	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Mathematics I and Mathematics II (BTIME01002 and BTIME02001)

Objectives:

- To develop a fundamental in analytical and practical Fluid mechanics.
- To impart knowledge of different types of fluid flows and boundary layers

Outcome:

After completion of the course, students would be able to:

- Understand fluid properties, and their static-dynamic nature.
- Analyze fundamental behavior of incompressible fluid,
- Understand and Evaluate the fundamentals of laminar and turbulent flow and boundary layer theory to solve real life problems.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Fluid Properties:** Concept of continuum, fluid properties, Classification of fluid, Newton's law of viscosity, stress-strain relationship.	04
2	**Fluid Statics**: Basic hydrostatic equation, Pascal's Law, application to Manometers and mechanical gauges, hydrostatic forces on plane and curved submerged surfaces. **Buoyancy and Floatation:** Archimedes' Principle, buoyancy force and centre of buoyancy, metacentre, metacentric height, analytical method to find metacentric height, condition of equilibrium of submerged bodies, oscillation of a floating body	10
3	**Fluid Kinematics:** Description of fluid motion-Lagrangian method and Euler's method, classification of flow types- steady and unsteady, uniform and non-uniform, laminar and turbulent, one two and three-dimensional flow, rotational and irrotational, laminar and turbulent, compressible and incompressible. Flow patterns- stream lines, path lines, stream tubes and streak lines. Continuity equation (Cartesian and polar co-ordinates), circulation and vorticity, velocity potential and stream function.	08
4	**4.1 Fluid Dynamics:** Euler's equation of motion, Bernoulli's equation and its applications-venturimeter, orificemeter, rotameter, pitot tube, Impulse Momentum equation and its applications.	08

5	**5.1 Laminar Flow:** Navier-Stokes equation of motion, developing expression for flow rate, pressure drop, shear stress, friction factor. Flow of viscous fluid in circular pipes- Hagen Poiseuille law, Couette flow. **5.2 Turbulent Flow**: Shear stresses in turbulent flow, theories of turbulent shear stress, hydro-dynamically smooth and rough surface, modeling of turbulence, Moody's chart. **5.3 Flow Through pipes:** Energy losses in pipes: Minor and Major losses, Darcy-Weisbatch equation for head loss in pipes, hydraulic gradient lines, and total energy lines, pipes in series and parallel.	10
6	**Boundary Layer Theory**: Concept of Boundary layer, Boundary layer over flat plate, Boundary Layer thickness, momentum thickness, displacement thickness and energy thickness. Von-Karman momentum integral equation. Separation and control and Concept of drag.	05
	Total	**45**

Text Books:

1. White Frank M. (2002), "Fluid Mechanics", *McGraw Hill.*
2. Som S.K., Biswas G. (2015), "Introduction to Fluid Mechanics and Fluid Machines", *TMH Delhi*

Reference Books:

1. Douglas John F., Janusz Gasiorek (2001), "Fluid Mechanics", 4th Edition, *Pearson Education.*
2. Kumar K.L. (2014), "Engineering Fluid Mechanics", S. Chand
3. Modi P.N., Seth S.M. (2015), " Hydraulics and Fluid Mechanics including Hydraulic Machines", *Rajsons Publications*
4. Escudier M.P. (2010), " The Essence of Engineering Fluid Mechanics", *Prentice Hall*
5. Subrmanyan K. (2005), "Fluid Mechanics", *Tata McGraw Hill.*
6. Giles R.V., Evett J.B., Cheng Liu(2013), "Fluid Mechanics and Hydraulics", Schaum Outline Series, 4th edition, *McGraw Hill*

Term work:

1. Assignments given by the faculty based on above syllabus (Min. 3).
2. Minimum 6 experiments from the list.

List of experiments:

1. To determine coefficient of discharge of Venturimeter
2. To determine coefficient of discharge of Orifice Meter
3. To determine friction factor of Pipe
4. To study minor losses in various Pipe Fittings
5. To determine viscosity of oil
6. To determine Reynolds's Number
7. Determination of Meta-centric Height

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Program: B. Tech. Integrated (Mechanical)				**Semester:** V	
Course: Engineering Mathematics – III				**Code:** BTIME05006	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Objectives:

- To provide an understanding of matrices to solve Engineering problems.
- Impart knowledge of Laplace transforms and Fourier series.

Outcomes:

After completion of the course, students would be able to :

- Apply Matrices, Laplace transforms, Fourier series to Engineering problems.
- Use the concepts of Matrices, Laplace transforms and Fourier series for solving problems.

Detailed Syllabus: (per session plan)		
Unit	**Description**	**Duration**
1.	**Matrices:** Characteristic equation, Eigen values and Eigen vectors of a square matrix, Cayley-Hamilton Theorem, Similar Matrices, Diagonalization, Functions of a Square Matrix, Quadratic Forms, Reduction of a quadratic form to canonical form using orthogonal transformation.	12
2.	**Laplace transform:** Definition, Laplace transform of $1, e^{at}, \sin at, \cos at, \sinh at, \cosh at, t^n$, Change of scale property, First shifting property, $L\{t^n f(t)\}, L\left\{\frac{f(t)}{t}\right\}, L\left\{\int_0^t f(u)du\right\}, L\{f^n(t)\}$, Inverse Laplace transform, Properties of Inverse Laplace transform, Inverse Laplace using partial fraction and Convolution Theorem. Laplace transforms of Periodic functions, Dirac delta functions, Unit step functions, Second shifting property. Application to solve initial and boundary value problems involving ordinary differential equations.	20
3.	**Fourier Series:** Orthogonality and orthonormality, Definition of Periodic function, Trigonometric Series, Dirichlet's conditions, Euler's formulae (Derivation of Fourier coefficients a_0, a_n, b_n is not expected), Fourier series for the interval $[\alpha, \alpha+2\pi]$ and $[\alpha, \alpha+2c]$, Even and Odd functions, Half range sine and cosine expansions, Parseval's identities.	13
	Total	45

Text Books:

1. Glyn James (2010), "Advance Modern Engineering Mathematics", *Pearson Education, 4th edition.*

Reference Books:

1. Erwin Kreyszig (2006), "Advanced Engineering Mathematics", *Wiley Eastern Ltd, 8th edition.*
2. Murray Spiegel (2005), "Schaum's Outline: Advanced Mathematics for Engineers and Scientists", *Tata McGraw Hill.*
3. B.V. Ramana (2010), "Higher Engineering Mathematics", *Tata McGraw Hill, 1st edition.*

Term Work:

As per institute norms.

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Program: B. Tech. Integrated (Mechanical)				**Semester:** V	
Course : Environmental Engineering and Management Systems				**Code:** BTIME05007	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	0	3	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Chemistry- I and II (BTIME01004 and BTIME02003)

Objectives:

- To educate students about the fundamental scientific principles of engineering to environmental problems.
- To understand environmental policies, programmes and systems that promote sustainable development.
- To coordinate all aspects of pollution control, waste management, environmental health and conservation.
- To understand the environmental policies and practices.
- To raise awareness about Indian laws for Environmental Protection.

Outcomes:

After completion of the course, students would be able to:

- Apply the principles upon which engineering practice is based, including physical, chemical, and biological science, mathematics and scientific computation; economics; and engineering science.
- Analyze the cross-media (air, water, earth) nature of environmental problems and the need for multidisciplinary approaches to their solution.
- Design systems, components, or processes that provide engineering solutions to environmental problems.
- Participate in Eco-friendly movements and conduct business ethically.

Detailed Syllabus: (per session plan)		**Duration**
Unit	**Description**	
1	**Ecosystems:** Concept, Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids. Classification, characteristic features, structure and functions of different Ecosystems - Forest, Grassland, Desert and Aquatic ecosystems.	08
2	**Environmental Pollution:** Definition, Classification, Causes, Effects and Control measures of different types of pollution - Air, Water, Soil, Noise, Marine, Thermal, Radioactive, Pesticide, Oil and E-Pollution. Pollution case studies.	08

3	**Solid Waste Management:** Definition, Classification, Characteristics, Segregation, Storage, Transportation and Management Practices and Disposal Methods. **Bio-Medical Waste Management:** Definition, Classification, Characteristics, Segregation Storage, Transportation, Treatment and Safe disposal. **Hazardous Waste:** Definition, Classification, Sources, Management Philosophy and Options, treatment and Safe disposal. **Disaster Management:** Causes, types, floods, tsunami, earthquake, cyclone and landslides.	08
4	**Renewable and Non-renewable Resources:** Natural resources and associated problems. **Forest Resources:** Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. **Water Resources**: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and Problems. **Mineral Resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies. **Energy Resources:** Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies. **Land Resources**: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources.	08
5	**Preventive Measures:** Basic human needs v/s over-consumerism; wastage, misuse and abuse of resources including energy, reuse, recycling and renovation techniques, mass education about environment, sustainable and eco-friendly development, legislative support for environmental protection, Role of NGOs. Role of an individual in prevention of pollution **Indian Laws for Environmental Protection:** Environment Protection Act. Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wasteland reclamation, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation	08
6	**Social Issues and Environmental Ethics:** Urban problems related to energy, Water conservation, rain water harvesting, and watershed management. Resettlement and rehabilitation of people. Definition, Causes, Effects, its problems and concerns – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.	05
	Total	**45**

Text Books:

1. KrishnamoorthyBala (2005), "Environmental Management", 1st edition, *Prentice Hall of India, New Delhi.*
2. Cunningham, W.P. (2009), "Principles of Environmental Science", *Tata McGraw Hill.*

Reference Books:

1. Dr. B. S. Chauhan (2008), "Environmental Studies", *University Science Press.*

Term Work:

1. Assignments given by the faculty based on above syllabus (Min. 3).
2. Site visit report, for the visit conducted in relevance with the syllabus

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SVKM's Narsee Monjee Institute of Management Studies

Mukesh Patel School of Technology Management & Engineering

Program: B. Tech. Integrated (Mechanical)				**Semester:** VI	
Course : Theory of Machines - II				**Code:** BTIME06001	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Theory Machine-I (BTIME05001)

Objectives:

- To introduce estimation of inertia forces in reciprocating parts of the engines.
- To impart knowledge of theory and working of flywheel.
- To provide the understanding about working of belt, rope, brakes and clutches.

Outcomes :

After completion of the course, students would be able to:

- Analyze the static and dynamic forces of flywheel for reciprocating prime movers and machines.
- Draw turning moment diagram for engines and explain working of flywheel.
- Select the machine components like belt, ropes and chains for required mechanisms.
- Distinguish between various types of clutches and brakes.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Inertia Forces in reciprocating parts:** Introduction, resultant effects of a system of force acting on a rigid body, D-Alembert's principle, Approximate analytical method for velocity and acceleration of the piston. Angular velocity and acceleration of the connecting rod. Forces on the reciprocating parts of an engine neglecting weight of the connecting rod. Equivalent dynamical system.	14
2	**Turning moment diagram and flywheels:** Introduction, Turning moment diagram for a single cylinder double acting steam engine, Turning moment diagram for a four stroke cycle internal combustion engine, turning moment diagram for a multi-cylinder engine, fluctuation of energy, determination of maximum fluctuation of energy, coefficient of fluctuation of energy, coefficient of fluctuation of speed, Energy stored in the flywheel, Dimension of flywheel rim.	12

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3	**Belts and Ropes:** Types of belts, velocity ratio, slip and creep of belt, length of belt for open and cross systems, law of belting, dynamic analysis- driving tensions, centrifugal tension, initial tension, condition of maximum power transmission.	09
4	**Friction Clutches and Brakes:** Pivot and Collar friction, Single and multiple plate clutch, Cone clutch, Centrifugal clutch, Torque transmitting capacity, Clutch operating mechanisms, types of brakes, shoe brakes, external and internal shoe brakes, block brakes, band brakes, and band and block brakes, internal expanding shoe brake.	10
	Total	**45**

Text Books:

1. Ratan S. S. (2009), "Theory of Machines", 3rd Edition, *Tata McGrew Hill, New Delhi.*
2. Thomas Beven (2009), "Theory of Machines", 3rd Edition, *Pearson.*

Reference Books:

1. Shigley J. E. (2003)," Theory of Mechanisms and Machines", 3rd Edition, *University Press.*
2. Ballaney P. L. (2005),"Theory of Machines and Mechanisms", 24th Edition, *Khanna Publishing, New Delhi.*
3. Ghosh and Malick (1988), " Theory of Mechanisms and Machines", *East West Press Pvt. Ltd. (claasic)*

Term work:

1. Assignments given by the faculty based on above syllabus (Min. 3).
2. Minimum 6 experiments from the list.

List of Experiments:

1. Study of various types of mechanisms and their inversions
2. To draw velocity diagram using Instantaneous centre method.
3. To draw velocity diagram using relative velocity method.
4. To draw velocity and acceleration diagram for simple four bar mechanism.
5. To draw velocity and acceleration diagram for mechanisms involving Corioli's component.
6. To find Slip of belt.
7. To study two and three position synthesis.
8. 8. To study synthesis for slider crank Mechanism.

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Program: B. Tech. Integrated (Mechanical)				**Semester :** VI	
Course : Mechanical Measurement and Metrology				**Code :** BTIME06002	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Physics-I and II (BTIME01003 and BTIME02002)

Objectives:

- To develop awareness and basic skills necessary for the reliable measurements and measuring instruments.
- To impart knowledge of methods of measurement of different engineering parameters like pressure, temperature, displacement, velocity, acceleration etc.
- To study different metrological instruments for linear, angular, taper and surface finish measurements.

Outcomes:

After completion of the course, students would be able to:

- Understand the significance of measurements, systems, instruments and their calibration.
- Select proper instruments and carry out the measurements successfully.
- Understand the construction, specifications and working of different measuring instruments.
- Analyse the impact of factors like surface finish on the performance of machines.
- Identify and use modern measurement instruments.

Detailed Syllabus: (per session plan)

Unit	**Description**	**Duration**
1	**Measurement:** Need of measurement, Study of instruments, measurement methods, generalized measurement system & its functional elements, instrument characteristics - static & dynamic characteristics, calibration.	04

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2	**Temperature Measurement:** Importance of temperature measurement, study of thermometer, thermocouple: principle, types, calibration, RTD, thermistors, pyrometers – principle and their applications.	04
3	**Measurement of Pressure and Vacuum:** Importance of pressure and vacuum measurement, Range of high pressure & vacuum: Bourdon tubes, Dead weight pressure gauge tester, diaphragm gauge, LVDT, Piezo-electric pressure gauge, Low vacuum gauges - McLeod gauge, thermal conductivity gauge, Pirani gauge, Ionization gauge.	06
4	**Strain Gauges**: Classification, electrical strain gauge: working principle and types, gauge factor (analytical treatment), analysis of Wheatstone's network using strain gauges, mounting of strain gauges.	06
5	**Metrology:** Definition and concept of metrology, standards of measurements, methods of measurement, precision and accuracy.	04
6	**Linear Measurement:** Line and end standards, Wavelength standards, Slip gauges, design and manufacture of gauges, **Comparators:** Types, construction and working of Mechanical, Optical, Electrical, Pneumatic comparators, **Interferometry:-** Basic principles, source of light, Optical flats, Fringe pattern and their interpretation	08
7	**Angular Measurement:** Angle standards, sine bar, angle gauges, autocollimator, angle Dekker, optical square, taper measurement, universal bevel protractor **Surface finish Measurement:** Surface texture, assessment of surface roughness, Tomlinson surface meter, and other surface measuring devices. **Screw Thread Metrology:** Screw thread terminology, measurement of thread parameters, study of thread gauges, floating carriage micrometer. **Gear metrology:** Gear profile and measurement of parameters, Study of Tool Maker's microscope and profile projector	08
8	**Advances in Metrology:** coordinate measuring machine, universal measuring machine, application of lasers in measurement, machine vision system, computer aided inspection.	05
	Total	**45**

Text Books:

1. Nakra and Chowdhury (2009), "Measurement and Control", 3 Edition, *Tata McGraw Hill.*
2. Jain R. K. (2009), "Engineering Metrology", *Khanna Publishers.*
3. Beckwith T.G. (2013) , "Mechanical Measurements"' 6th Edition, *Pearson*

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Reference Books:

1. Sawhney A. K. (2012), "Electrical and Electronic Measurements and Instrumentation", *Dhanpat Rai and Sons.*
2. *Doebelin* E.O. and *Manik* D. N. (2010), "*Doebelin's* Measurement Systems", *Mc Graw Hill*, 6th Edition.

Term Work:

1. Minimum 6 experiments from the list below
2. Assignments based on the above syllabus (Min. 3).

List of Experiments:

1. Temperature Measurement using thermocouples, RTD, Thermistor.
2. Testing of mechanical pressure gauge using Dead Weight pressure tester.
3. Use of strain gauges.
4. Determination of Linear/ Angular dimensions of a part using precision/non-precision measuring instruments i.e. Vernier caliper, height gauge, micrometer etc.
5. Experiments on slip gauges.
6. Measurement of surface finish and testing of surface flatness by optical flat.
7. Measurement of Screw Thread using Floating Carriage.
8. Measurement of Gear Tooth Thickness by Gear Tooth Vernier Caliper.
9. Study and applications of profile projector.

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Program: B. Tech. Integrated (Mechanical)				**Semester:** VI	
Course: Fluid Machinery				**Code:** BTIME06003	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Physics I (BTIME01003), Fluid Mechanics (BTIME05004)

Objectives:

- To provide understanding of working principles of fluid machines.
- To impart the knowledge of characteristics of the components of fluid machines.

Outcome:

After completion of the course, students would be able to:

- Understand different types of fluid machinery and their working principles.
- Understand design parameters and performance characteristics of hydraulic turbines, positive displacement & centrifugal pumps with interpretation.
- Describe governing of hydraulic turbines.
- Predict the performance of the hydraulic turbines using similarity method.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Principles of hydraulic machines:** Impacts of jet on flat plate and cured vanes, elements of a hydro power plant, types of heads and efficiencies. Theory of impulse and reaction machines, Euler's energy equation applied to a turbine and pump, velocity triangles, expression for work done.	04
2	**Impulse Turbine:** **Pelton Turbine:** Components of a Pelton turbine, velocity triangles speed ratio, jet ratio, and estimation of various parameters like head, discharge, and efficiency etc., determination of number of buckets. Performance curves, governing of turbine.	07
3	**Reaction Turbines:** Types of reaction turbines - inward and outward flow, radial mixed and axial; elements of the turbine, estimation of various parameters, draft tubes. Francis Turbine – velocity triangles construction , working and	08

	performance, Kaplan Turbine – velocity triangles construction, working and performance, governing of turbine.	
4	**Dimensional analysis and Similarity:** Secondary or derived quantities, Reyleigh method, Buckingham– π theorem, dimensionless numbers- Geometrical, Kinematics and Dynamic similarity. Similarity relations in turbines, definition of unit quantities and specific quantities.	06
5	**Pumps:** Introduction, Classification of pumps - positive displacement and non - positive displacement. **Reciprocating Pump :** Basic theory, construction, operation, Slip, Indicator diagram. Types of reciprocating pumps, indicator diagram, use of air vessel. **Rotary Pumps:** Basic theory, types, construction and working, variable delivery pumps	08
6	**Centrifugal pumps:** Basic Theory, Euler's equation and velocity triangles, classification, construction, operation, characteristics. Priming of pumps. Series and parallel operation of pumps. Cavitations and NPSH (NPSHA, NPSHR)	08
7	**Cavitation:** Cavitation in turbines - causes, effects and remedies, Thoma's cavitation parameter σ. Use of σ Vs specific speed graphs.	04
	Total	45

Text Books:

1. Subrmanya K. (2013), "Hydraulic Machines", *Tata McGraw Hill.*
2. Cengel Yunus A. and Cimbala John (2008), "Fluid Mechanics", 2nd Edition, *Tata McGraw Hill.*

Reference Books:

1. Modi P.N., Seth S.M. (2015), " Hydraulics and Fluid Mechanics including Hydraulic Machines", *Rajsons Publications*
2. Sahu G.K. (2013), " Pumps", *New Age International*
3. White Frank M. (2008), "Fluid Mechanics", 6th Edition, *McGraw Hill.*
4. Som and Biswas (2003), "Fluid Mechanics and Machinery", *TMH Delhi.*
5. Jagdishlal (2000), "Hydraulic Machines", *Metropolitan Book Co.*

Term work:

1. Assignments given by the faculty based on above syllabus (Min. 3).

List of Experiments:

1. Performance test on impact of jet
2. Performance test on Pelton turbine.
3. Performance test on Francis turbine.
4. Performance test on Kaplan Turbine.
5. Performance test on centrifugal pump.
6. Performance test on reciprocating pump.
7. Performance test on axial flow pump, gear pump.
8. Study of multistage pump.
9. Performance test on Hydraulic Ram.
10. Study of Hydrostatic components systems.
11. Study of Hydrostatic systems.
12. Study of governing of hydraulic turbine.

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Program: B. Tech. Integrated (Mechanical)				**Semester:** VI	
Course: Thermal Engineering				**Code:** BTIME06004	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Mathematics - I and II (BTIME01002 and BTIME02001), Engineering Thermodynamics (BTIME03002)

Objectives:

- To make the students acquire the skills to analyze the performance of gas power cycle and vapor power cycle.
- To impart knowledge of compressible flows essential for the design of nozzles and understand the working of compressors and steam turbines.
- To introduce the fundamental concepts in combustion.

Outcomes:

After completion of the course, students would be able to:

- Understand the working of various types of compressors and steam turbines and analyzing their performance.
- Apply fundamentals of compressible flow to gas and steam nozzles.
- Explain gas power cycle, vapour power cycles and analyze their performance.
- Analyze the combustion process and carry out flue gas analysis.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Air Compressors:** classification, single stage and multi stage reciprocating compressors; p-V diagram for an actual compressor, diagram factor, expression for work input and volumetric efficiency, inter-cooling, effect of clearance volume. Rotary compressor, classification, centrifugal compressor, working, velocity diagram.	08
2	**Gas and Steam Nozzles:** Compressible fluid flow through nozzles, diffusers, and constant area ducts; Stagnation properties; Mach Number, Isentropic flow, Fanno and Rayleigh Lines, use of gas tables, steam tables – flow through nozzles, critical pressure ratio and effect of back pressure.	09

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3	**Vapour Power Cycles:** Carnot vapour power cycle; simple Rankine cycle; performance and efficiency; analysis of modified Rankine cycles like reheat cycle, regenerative cycle. Types of feed water heaters and their analysis; reheat-regenerative cycle; binary vapour cycle; process heat and by-product power; efficiencies of steam power plant.	08
4	**Gas power cycles:** Carnot gas power cycle and its limitations. Analysis of air standard Otto, Diesel and Dual combustion cycles and their comparison. Analysis of simple gas turbine cycle (Brayton cycle); reheat, regeneration, intercooling, effect of operating variables on thermal efficiency of gas turbine. Analysis of turboprop and turbojet engine cycles.	10
5	**Steam turbines:** Impulse turbine, reaction turbine, velocity compounding, pressure compounding, velocity diagrams for single and multistage turbines, power developed, efficiencies, degree of reaction, Parson's reaction turbine.	10
	Total	45

Text Books:

1. P. K. Nag (2010), "Basic and Applied Thermodynamics", 2nd Edition, *Tata McGraw Hill*.
2. M. M. Rathore (2010), "Thermal Engineering", *Tata McGraw Hill*.

Reference Books:

1. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. B. (2010). Fundamentals of engineering thermodynamics. John Wiley & Sons.
2. Y. A. Cengel and M. A. Boles (2003), "Thermodynamics – An engineering Approach", *Tata McGraw Hill*.
3. V. Kadambi and M. Prasad (1974) (Classic), "An Introduction to Energy Conversion – Volume II Energy Conversion Cycles", *Wiley Eastern*.
4. P.K.Nag (2008), "Power plant engineering", 3rd edition", *Tata McGraw Hill*.
5. V.Ganesan (2010), "Gas Turbines", 3rd edition, *Tata McGraw Hill*.
6. S.M.Yahya (2011), "Turbine Compressor and Fans", 4th edition, *Tata McGraw Hill*.

Term Work:

1. Assignments covering syllabus (Min. 3).
2. Viva examination on fundamental concepts

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Program : B. Tech. Integrated (Mechanical)				**Semester :** VI	
Course : Presentation and Communication Techniques				**Code :** BTIME06006	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**	**Term End Examinations (TEE) Theory (------)**
2	0	2	0	Scaled to 50 marks	----

Course Objectives:

- The student will demonstrate an understanding of the cardinal concepts of business communication.
- The student will be able to identify the barriers in organizational communication and proactively overcome them.
- The student will recognize the attributes that devise an effective presentation.
- The student will be able to infer and apply the various strategies in the creation and delivery of presentations especially in a formal set up.
- The student will be able to extend the learning of models and strategies of interviews, meetings and conferences to the professional scenario.

Course Outcomes:

After completion of the course, students would be able to :

- Employ the postulates of technical writing in a formal set–up.
- Write well-structured resume and application letters based on fundamentals of business correspondence.
- Assess group dynamics and apply leadership skills for effective team building in an organization.
- Analyze the context and select appropriate communication techniques for effective interpersonal communication especially during an interview.

Detailed Syllabus		**Duration**
Unit	**Description**	
1.	**Communication in a Business Organization** : Internal & External Communication; Channels of Communication. Types of meetings, strategies for conducting successful business meetings, documentation (notice, agenda, minutes, resolutions) of meetings.	06
2.	**A. Advanced technical writing: Report writing** Definition and importance of reports, qualities of reports, language and style in reports, types of reports, formats (letter, memo, project, reports). Methods of compiling data for preparing report. A computer aided presentation of a technical project report based on survey, based or reference based topic. The topics are to be assigned to a group of 8-10 students. The written report should not exceed 20 printed pages. **B. Presentation Skills**: Elements of an effective presentation, Structure of a presentation, Presentation tools, Audience analysis.	10

	Language: Articulation, Good pronunciation, Voice quality, Modulation, Accent and Intonation	
3.	**Interpersonal Skills**: Team Building, Goal Setting and Decision making, Time-Management, Leadership skills.	06
4.	**Career Skills:** Preparing resumes and cover letters. Types of Resumes. Interview techniques: Preparing for job interviews, facing an interview, verbal and non-verbal communication during interviews, observation sessions and role-play techniques to be used to demonstrate interview strategies (mock interviews)	04
5.	**Group Discussion**: Group discussion as part of selection process. Structure of a group discussion, Dynamics of group behavior, techniques for effective participation, Team work and use of body language.	04
	Total	**30**

Text Books:

1. Fred Luthans : Organizational behavior, *McGraw Hill* **[Twelfth Edition, 2013 (Indian edition)]**
2. R. C. Sharma & Krishna Mohan: Business Correspondence & Report writing, *Tata McGraw Hill Publications*. **[Fourth Edition, 2010]**
3. Dr. Meenakshi Raman & Dr. Sangeeta Sharma: Technical Communication: Principles and Practice. *Oxford University Press* **[Second Edition, 2012]**

Reference Books:

1. Rai Urmila, Rai S. M. Business Communication, *Himalaya Publishing House* **[Second Edition, 2013]**
2. Effective Technical Communication : Ashraf Rizvi, *McGraw Hill* **[2010]**
3. Business Communication K. K. Sinha, Taxmann **[Fourth Edition, 2012]**
4. Kitty O Locker, Stephen Kyo Kaczmarek : Business Communication : Building Critical Skills, *McGraw Hill Higher Education* **[Sixth Edition, 2013]**.

Term Work:

Report & Journal Work

1. Three assignments on report writing
2. Three assignments on interpersonal skills
3. Two assignments on career skills (Practical sessions)
4. Practical sessions on Group Discussion topics
5. One assignment on Technical Paper presentation

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Program: B. Tech. Integrated (Mechanical)				**Semester:** VI	
Course: Engineering Mathematics – IV				**Code:** BTIME06007	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Objectives:

- To provide the understanding and use of Complex variables.
- Acquire knowledge of statistical methods and linear programming problems.

Outcomes:

After completion of the course, students would be able to :

- Solve problems involving functions of complex variables, random variables, probability distribution, Testing of Hypothesis and operations research.
- Identify the suitable methods of complex variables, random variables, probability distribution, Testing of Hypothesis and operations research to solve real life problems.
- Apply knowledge of complex variables, random variables, probability distribution, Testing of Hypothesis and operations research to Engineering problems.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1.	**Complex Variables :** Functions of Complex Variables Analytic Function, Cauchy-Riemann Conditions for Analytic Functions, Harmonic Functions, Milne-Thompson method to determine analytic function when it's real or imaginary or its combination is given. Conformal transformation: Standard transformations such as translation, rotation and magnification, inversion and reflection. Bilinear transformation, cross ratio, fixed points.	12
2.	**Random Variables:** Discrete and continuous random variables, probability density function, cumulative distribution function, mean, variance, moments and moment generating functions. Relation between raw moments and central moments.	08
3.	**Probability Distribution:**	08

	Discrete Probability Distribution: Binomial Distribution, Poisson Distribution, Continuous Probability Distribution: Normal Distribution, Mean and Variance of the above distributions.	
4.	**Testing of Hypothesis:** Large Sample Tests: tests for mean. Small sample tests: Student's t-test, F- test.	08
5.	**Introduction to Operations Research:** Linear Programming Problems: Problem Formulation, Graphical method, Simplex method, Big-M method.	09
	Total	**45**

Text Books:

1. H. K. Dass (2008) "Advanced Engineering Mathematics", *S. Chand & Co., 18th edition.*
2. J. K. Sharma (2010), "Operations Research Theory and Applications", *Macmillan, 4th Edition.*

Reference Books:

1. Glyn James (2010), "Advance Modern Engineering Mathematics", *Pearson Education, 4th edition.*
2. S. P. Gupta (2007), "Statistical Methods", *Sultan Chand & Sons, 35th Edition.*
3. Erwin Kreyszig (2010), "Advanced Engineering Mathematics", *Wiley Eastern Ltd, 10th Edition.*
4. T. Veerarajan (2008), "Probability, Statistics and Random Processes", *Tata McGraw Hill, 2nd Edition.*
5. V. K. Kapoor (2007), "Operations Research", *Sultan Chand & Sons, 4th Edition.*

Term Work:

As per institute norms.

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SVKM's Narsee Monjee Institute of Management Studies

Mukesh Patel School of Technology Management & Engineering

Program: B. Tech. Integrated (Mechanical)				**Semester :** VII	
Course: Heat Transfer				**Code :** BTIME07001	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Engineering Thermodynamics (BTIME03002)

Objectives:

- To provide knowledge of different modes of heat transfer.
- To study different laws of conduction, convection and radiation.
- To provide understanding of different applications of conduction, convection and radiation.

Outcomes:

After successful completion of this course, students should be able to

- Understand the principles of conduction heat transfer in steady and unsteady state.
- Apply the principles of conduction in calculating heat transfer through various configurations.
- Interpret and use of non-dimensional parameters in convection heat transfer, concept of thermal boundary layers.
- Understand principles of radiation heat transfer between non- black bodies and shape factor.
- Calculate the important parameters of heat exchangers.

Detailed Syllabus

Unit	Description	Duration
1	**Basic Concepts** Modes of Heat Transfer, its mechanism and mathematical models. **Conduction Heat Transfer:** Fourier's general conduction equation in Cartesian, Cylindrical and Spherical co-ordinates (for cylindrical and spherical walls derivation of Fourier's three-dimensional equation is not included), thermal resistance, solution of Fourier's equation for one dimensional steady state heat conduction through various configurations such as plane, cylindrical, spherical wall, composite medium. Critical thickness of insulation and its importance. **Heat Transfer from extended surfaces:** Types of fins, Governing equation, fin effectiveness, efficiency of fins, concept of corrected fin length, application of fins.	13
2	**Unsteady State Heat Conduction:**	04

	Lumped System Analysis, heat transfer in Semi Infinite solids, use of Transient-Temperature Charts.	
3	**Convection Heat Transfer:** Forced and natural convection, hydrodynamic and thermal boundary layer, Convection heat transfer coefficient, Momentum and energy equation for laminar boundary layer, Laminar and Turbulent flow, Reynolds– Colburn analogy between momentum and heat transfer, principles of dimensional analysis, physical significance of dimensionless numbers, Nusselt number, Prandtl number, Reynolds number, Grashof number. Empirical relations and their use for forced internal and external convection for circular and non-circular ducts.	13
4	**Thermal Radiation:** Introduction to physical mechanism, concept of black body, grey body and radiation properties. Microwave Heating. Basic laws of radiation; Planck's law, Kirchoff's law, Stefan-Boltzman law, Wein's-displacement law and Lambert's Cosine law, Intensity of radiation, radiosity, shape factor for simple geometries, heat exchange between non-black bodies, Radiation Shield.	07
5	**Heat Exchanger:** Classification, temperature distribution in parallel and counter flow arrangement, overall heat transfer coefficient, fouling factor, log mean temperature difference method, Effectiveness-NTU method.	8
	Total	**45**

Text Books:

1. J. P. Holman (2010), "Heat Transfer", 9th Edition, *Tata McGraw Hill.*
2. Yunus Cengel (2008), "Heat and Mass Transfer, A Practical Approach", 5th Ed, *Tata McGraw Hill.*

Reference Books:

1. P.K Nag (2016), "Heat and Mass Transfer", 3rd Edition, *Tata MCgraw Hill*
2. Frank Kreith, R.M. Manglik, Mark S. Bohn (2011), "Principles of Heat Transfer" 7th Edition, *Cengage Learning.*
3. S. K. Som (2008), "Introduction to Heat Transfer", *PHI Learning.*
4. Frank P Incropera and D.P. Dewitt (2011), "Introduction to Heat Transfer", *John Wiley & Sons.*
5. N.V. Suryanarayana (2015), Engineering Heat & Mass Transfer, 2nd Edition, *PENRAM.*

Term Work:

1. Assignments based on syllabus (Min. 3).
2. Minimum 8 (Eight) experiments from following list
3. Practical and Viva examination

List of experiments :

1. Determination of Thermal Conductivity of Insulating material
2. Determination of Thermal Conductivity of Composite Wall
3. Determination of heat transfer coefficient of air in transient cooling
4. Determination of heat transfer coefficient of air in transient heating
5. Calibration of thermocouples
6. Determination of heat transfer coefficient in natural convection
7. Determination of heat transfer coefficient in forced convection
8. Determination of Temperature distribution, fin efficiency in natural and forced convection.
9. Determination of Emissivity of a Test Surface.
10. Determination of Stefan Boltzmann Constant.
11. Determination of Log mean temperature difference, Overall Heat Transfer Coefficient and Effectiveness of heat exchanger in parallel and counter flow arrangement.
12. Determination of Log mean temperature different, heat transfer coefficient in shell side and tube side fluid.
13. Determination of Log mean temperature difference, heat transfer rate and over all heat transfer coefficient of Finned Tube Heat Exchanger.

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Program: B. Tech. Integrated (Mechanical)				**Semester :** VII	
Course: CAD/CAM/CIM				**Code :** BTIME07002	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Engineering Drawing I,II (BTIME01006, BTIME02006), Manufacturing Processes-I (BTIME03001), Manufacturing Processes-II (BTIME04001)

Objectives:

- To introduce the basics of backend of drafting packages.
- To give hands on experience on the 3D Modelling software.
- To impart knowledge of NC/CNC machines and programming of CNC using machine codes.
- To provide concepts of GT, CAPP, CAQC and CIM.

Outcomes:

After completion of the course, students would be able to:

- Use CAD/CAM packages in work environment for modelling.
- Transform and manipulate objects, store and manage data.
- Prepare part programming applicable to CNC machines.
- Understand concepts of GT, CAPP and CAQC.
- Demonstrate use of CAD/CAM in CIM systems.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction and Elements of interactive computer graphics:** The design process, the role of modeling and communication. Modeling using CAD, product life cycle and CAD/CAM, Concurrent engineering in product design and development, Collaborative Engineering, Computers for design process, CAD System Architecture-Hardware & Software.	08
2	**Techniques for geometric modeling:** The parametric representation of geometry-Bezier curves, Cubic spline curve, B-Spline curve, Constructive solid geometry (CSG), Boundary representation (B-rep), Wire Frame modeling, Solid modeling, Surface modeling, feature based modeling, Feature recognition and Design by feature.	06
3	**Transformation, Manipulation and Data Storage:** 2D and 3D Transformations (Translation, Rotation, Scaling and Magnification), Concatenations, Matrix representation, Problems on Transformations. Object transformation, mirror transformation, Bill of Materials from attribute data, Engineering data management	08

	system, relational data base for design, object oriental database, Design Information Systems.	
4	**NC and CNC technology**: Introduction, basic components of NC system, NC procedure, NC coordinate systems, NC motion control systems, Applications, Advantages and Disadvantages of NC machines. CNC programming concepts, Trends and new developments in CNC, Part programmers job, functions of a post processor, CNC subroutines, Constructional details of CNC machines, Feedback devices-Velocity and displacement. Flexible Manufacturing Systems (FMS), Machining Centers and its types, Automated Material Handling and Storage Systems like Robots, Automated Guided Vehicles (AGV) and Automated Storage and Retrieval Systems.	10
5	**Group Technology, CAPP and CAQC:** Introduction to GT, Part families, Part Classification and Coding, GT Machines cells, Benefits of GT. Introduction to CAPP, Retrieval type Process Planning Systems, Generative type Process Planning Systems, Benefits of CAPP, PFA, Similarity coefficient matrix. Introduction to Computer Aided Quality Control (CAQC), Computers in QC, Contact Inspection Methods, Non-Contact Inspection Methods, Integration of CAQC with CAD/CAM.	07
6	**Computer Integrated Manufacturing and Technology driven practices:** Introduction, Evolution, Objectives, CIM Hardware and software, CIM Benefits, Nature and role of elements of CIM, Identifying CIM needs, Data base requirements of CIM, Role of CAD/CAM in CIM, Obstacles to Computer Integrated Manufacturing, CIM wheel, DFM and DFA. Introduction to Rapid Prototyping, Virtual Prototyping.	06
	Total	**45**

Text Books:

1. Groover, Mikell, and E. W. J. R. Zimmers, (2008), "CAD/CAM: computer-aided design and manufacturing", *Pearson Education.*
2. Ibrahim Zeid, R. Sivasubramanian (2009), "CAD/CAM, Theory and Practice", *Tata McGraw Hill Publications.*

Reference books:

1. P. N. Rao (2010), "CAD/CAM Principles and Applications" Tata McGraw *Hill Publications.*
2. P. Radhakrishan, S. Subramanyan, V. Raju (2004), "CAD/CAM/CIM", *New Age International Publishers.*

Term Work:

1. Assignments based on syllabus (Min. 3).
2. Laboratory assignments on Solid modeling using any 3D modeling software. (Min. 4)
3. Part programming and part fabrication on CNC trainer (Turning / Milling). (Min. 2)
4. Viva-voce
5. Fabrication of physical 3D mechanical model using any one of the rapid prototyping processes

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Program: B. Tech. Integrated (Mechanical)				**Semester :** VII	
Course: Design of Machine Elements - I				**Code:** BTIME07003	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Engineering Mechanics (BTIME03007) , Strength of Material (BTIME04003) and Material Engineering (BTIME05003)

Objectives:

- To impart the knowledge of design considerations with material selection and functional utility of components.
- To introduce the design concept of simple machine components like shafts, keys, couplings and fasteners under static load condition based on strength and stiffness criteria.

Outcomes:

After completion of the course, students would be able to:

- Select appropriate materials for safe design.
- Understand the principle and basic procedure of machine components design.
- Analyze the different types of loads and stresses acting on components.
- Design of simple machine components like shafts, keys, couplings and fasteners under static loads.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction:** Definition, classification of machine design, General consideration of machine design, general procedure of machine design, engineering materials, material properties, materials selection.	03
2	**Fundamentals of design**: Sources of design data, use of standards, synthesis and creativity, simple stresses in machine parts, torsional and bending stresses in machine parts, factor of safety, service factor, maximum normal stress theory, maximum shear stress, maximum distortion energy theory.	08
3	**Design of simple machine parts:** Introduction, types of cotter joints, leavers, design of cotter joint, design of knuckle joint, design of levers (hand leaver, foot leaver, bell crank lever, leaver for safety valve) and design of turn buckle.	08
4	**Design of keys**: Introduction, types of keys, Saddle keys, sunk keys, forces acting on a sunk keys, strength of sunk keys, and effect of keyways, feather and woodruff keys.	08

	Design of coupling: Introduction, types of coupling, design of Muff, flange, flexible and bush pin coupling.	
5	**Design of shafts:** Introduction, materials used for shafts, ASME code, design of shaft on strength and torsional rigidity basis, design of transmission shaft.	09
6	**Design of fasteners:** Bolted joints, riveted joints, and welded joints and design for transverse and eccentric loading.	09
	Total	**45**

Text Books:

1. J. F. Shigley (2008), "Mechanical Engineering Design", 8th Edition, *Tata McGraw Hill.*
2. V. B. Bhandari (2010), "Design of Machine Elements", 3rd Edition, *Tata McGraw Hill Publication.*

Reference Books:

1. M. F. Spotts (2004), "Design of Machine Elements", 8th Edition, *Pearson Publication.*
2. M. Tooley (2009), "Design Engineering Manual", *Elesvier, Butterworth - Heine mann.*
3. PSG design data book PSG college-Kalaikathir Achchagam , Coimbatore paperback – 2012

Term Work:

1. Design and preparation of working drawings – minimum three exercises from topics indicated in the syllabus
2. Assignments based on the above syllabus (Min. 3).
3. Viva Voce Examination

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Program : B. Tech. Integrated (Mechanical)				**Semester :** VII	
Course : Industrial Engineering				**Code :** BTIME07004	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Manufacturing Processes - I (BTIME03001)

Objectives:

- To introduce various approaches to productivity.
- To impart knowledge of work-study and ergonomics to enable working effectively with minimization of occupational stresses.
- To introduce the concept of value engineering and applications.

Outcomes:

After completion of the course, students would be able to:

- Calculate the measures of productivity of resources for the improvements.
- Improve and evaluate the methods to measure parameters such as time and magnitude of activities performed.
- Assess the cost effectiveness of each function of the product in terms of usefulness to the customer.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Productivity:** Productivity concepts, Analysing the work content of a job to identify and reduce/eliminate the excess work content. Significance of theory of Scientific Management. Improving Efficiency and Productivity through Work study. Work study components. Relationship between Method Study and Time Study.	07
2	**Method Study:** Basic procedure of method study. Factors in selecting a job to a studied. Recording the facts with charts and diagrams. Development and selection of new method, Principles of motion economy, Installing and maintaining the proposed method.	10
3	**Work Measurement**: Significance of work measurement. Techniques of work measurement. Need of work sampling technique. Conducting work sampling study. Analytical estimation of work. Concept of rating factor. Consideration of various allowances. Standard time for work. Use standard data.	11

4	**Ergonomics:** Definition of Ergonomics, Ergonomics principals. Objective of Human engineering, Aims of ergonomics, Man-Machine system, Anthropometrical details - Database of human factors. Ergonomic improvement of physical and cognitive issues. Work space and arrangement.	08
5	**Value Engineering:** Definition of Value Engineering, Uses of Value Engineering, Reasons for unnecessary costs, Difference between Value Engineering and other cost reduction techniques. Case studies	09
	Total	**45**

Text Books:

1. George Kanawaty (2008), "Introduction to Work Study", 3rd Edition, *ILO, Geneva*, Oxford And IBH Publishing
2. Ralph Barnes (2005), "Time & Motion study", *Asia Publishing*.

Reference Books:

1. M. S. Sanders & E J McCormick (2003), "Human factors in Engineering & Design", *Tata McGraw Hill*.
2. Merton E. Davis, William D. Falcon, Value Analysis (2002), "Value Engineering: The Implications for Managers", *American Management Association*.
3. Anil Kumar Mukhopadhyaya, (2003), "Value Engineering: Concept, Technique and Applications", SAGE Publications.

Any other information :

Term work:

1. Assignment on above syllabus (Min. 3).
2. Report on Experiments given below and presentation.

List of Experiments:

1. Experiment on rating to understand the concept of Standard Time.
2. Experiment on appropriate Recording Techniques of Method Study.
3. Experiment on Layout of Physical facilities (using Flow diagram/ String diagram/ Travel chart or any other technique)
4. Experiment on Designing a Workplace / workstation for any process using principles of Motion Economy.
5. Study Experiment on Ergonomic assessment of an Industrial product.
6. Case Study for Value Engineering

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Program: B. Tech. Integrated (Mechanical)				**Semester:** VII	
Course: Vibration Engineering				**Code:** BTIME07005	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Strength of Material (BTIME04003), Engineering Mathematics - I, II, III, IV (BTIME03004, BTIME04005, BTIME05006, BTIME06007), Theory of Machines - I and II (BTIME05001, BTIME06001)

Objective:

- To introduce the concept of vibration of mechanical systems.
- To impart the knowledge of free and forced vibration.
- To provide understanding of the natural frequency of the system and resonance of system.
- To impart the knowledge of balancing of mechanical systems.

Outcomes:

After completion of the course, students would be able to:

- Develop the equations of motion of various vibrating systems and examine the response of the system.
- Design the systems that are out of natural frequency to avoid resonance.
- Estimate the parameters of vibration isolation system
- Evaluate natural frequencies and articulate systems for application requiring vibrations such mechanical vibrators, vibratory separators and pneumatic drills etc.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Basic concept of vibration:** vibration and oscillation, causes and effects of vibration, vibration, parameters, degree of freedom, vibration classification **Free undamped vibrations:** Equilibrium method, energy method, and Rayleigh's method, Equivalent stiffness of spring combinations, Compound pendulum, Transverse Vibration, Beams with several masses. **Free damped vibration:** types of damping: viscous and coulomb damping, differential equations of damped free vibration, logarithmic decrement.	10
2	**Forced vibration:** Sources of excitation, equation of motion with harmonic force, response of rotating and reciprocating masses, support motion, vibration isolation and absorption, force and motion transmissibility. Vibration Measurement and Control.	10
3	**Free undamped Multi-degrees of Freedom Systems:** vibration of two and Multi-degrees of Freedom Systems, determination of natural frequencies, matrix method, Eigen value and Eigen vectors,	12

	Lagrange's equation. Approximate methods- Dunkerley's, Rayleigh's, Holzer's method.	
4	**Torsional vibration:** free torsional vibration of single, two and three rotor system, torsionally equivalent shaft, torsional dampers. Critical speed of shaft undamped, Maxwell theorem of reciprocal deflection.	05
5	**Balancing:** Balancing of rotating masses, static and dynamic balancing, balancing of reciprocating masses inline engines, balancing of V engines.	08
	Total	**45**

Text Books :

1. S. S. Rao (2004), "Mechanical Vibration", *Addison Wesley.*
2. S. Graham Kelley (1996), "Theory and Problems of Mechanical Vibrations Schaum Outline Series", *Mc-Graw Hill.*

Reference Books:

1. J. S. Rao (1994), "Advanced Theory of Vibration", *New Age international.*
2. S. Graham Kelley (2000), "Fundamentals of Mechanical Vibrations" *McGraw Hill.*
3. Jacob Pieter Den Hartog (1985) (Classic), "Mechanical Vibration", *Courier Dover Publications.*

Term Work:

1. Assignments based on syllabus (Min. 3).
2. Experiments to be performed in the laboratory from the following list of experiments
3. Viva voce

List of Experiments:

1. Experimental prediction of natural frequency of compound pendulum, prediction of equivalent simple pendulum system
2. Experimental prediction of natural frequency for longitudinal vibration of spring, and spring in series and parallel
3. Experimental prediction of natural frequency, and nodal points for single rotor and two rotor vibratory system
4. Experimental investigation of viscous damping, prediction of system parameter (spring stiffness, damping coefficient) from damped oscillations
5. Compute the natural frequency and predict the response for a one-degree-of- freedom system undergoing translational vibrations, with or without damping
6. Compute the resonant frequency and predict the response for a machine with a rotating unbalance
7. Experimental balancing of single and multi-rotor system
8. Experimental and theoretical investigation of whirling of shaft
9. Vibration analysis of mechanical system using MATLAB

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Program : B. Tech. Integrated (Mechanical)				**Semester :** VII	
Course : Theory of Machine-III				**Code :** BTIME07006	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Theory of Machines – II (BTIME06001)

Objectives:

- To develop an understanding of the short and medium term planning and control function of production at middle and operational level.
- To focus on functions for estimation and allocation of resources.
- To impart knowledge of procedures for meeting production and inventory targets in production organizations covering a wide range product type

Outcomes:

After completion of the course, students would be able to :

- Understand and construct various types of Cam profile and analyze the standard motion of the follower.
- Compare different type of gear and its applications.
- Design gear trains for different applications.
- Apply gyroscopic couple on stability of an automobile, airplane and ship.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Cams and Followers:** Types of cams and followers, Analysis of standard motions of the follower, Simple harmonic motion; Uniform velocity motion; Uniform acceleration motion, Layout of CAM profiles; determination of cam profiles for given follower motions, analysis of cams.	09
2	**Gears:** **Spur Gears**: Terminology, conjugate action, involute and cycloidal profile, path of contact, arc of contact, contact ratio, interference, undercutting, Methods to avoid interference and undercutting, Rack shift, Effect of center distance variation, friction between gear teeth, internal gears. **Helical Gears:** Normal and transverse module, torque transmitted by helical gears on parallel shafts. **Spiral Gears:** Spiral angle, shaft angle, efficiency of spiral gears, worm and worm gears.	15

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	Bevel Gears: terminology, geometrical relationships, applications and tooth forces. torque transmitted.	
3	**Gear trains:** Types of gear trains (Simple, compound, reverted and epicyclic). Velocity ratio, Tooth load, transmitted torque, holding torque.	11
4	**Gyroscope:** Principle, gyroscopic couple, effect of gyroscopic couple on stability of an automobile, gyroscopic effect on two wheelers, stabilization of sea vessel, four wheels and aeroplanes.	10
	Total	**45**

Text Books:

1. Thomas Beven (2009), "Theory of Machines", 3rd Edition, *Pearson*.
2. S. S. Rattan (2007), "Theory of Machines", 4th Edition, McGraw Hill.

Reference Books:

1. J. E. Shigley (2003), "Theory of Mechanisms and Machines", 3rd Edition, *University Press*.
2. P. L. Ballaney (2005), "Theory of Machines and Mechanisms", 24th Edition, *Khanna Publishing, New Delhi*.

Term work:

1. Assignments given by the faculty based on above syllabus (Min. 3).
2. Minimum 6 experiments from the list.

List of Experiments:

1. Study of cam and follower systems and Verification of cam jump phenomenon.
2. To draw cam profiles for various types of follower motions.
3. Study of various types of gearboxes such as industrial gear box, gearbox, differential gearbox, PIV gearbox.
4. To draw conjugate profile for any general type of gear tooth.
5. To generate involute gear tooth profile and to study the effect of undercutting and rack shift using models.
6. To study epicyclic gear trains and to measure torque, transmitted and holding torque.

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SVKM's Narsee Monjee Institute of Management Studies
Mukesh Patel School of Technology Management & Engineering

Program: B. Tech. Integrated (Mechanical)				**Semester:** VIII	
Course: I. C. Engines				**Code:** BTIME08001	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Fluid Mechanics (BTIME05004), Thermal Engineering (BTIME06004)

Objectives:

- To impart the knowledge of working of internal combustion engines and analysis of engine cycles.
- To provide the understanding of combustion processes in SI and CI engines and its influence on engine performance and the need for engine cooling.
- To introduce engine performance parameters, heat balance sheet and performance curves.
- To introduce alternate fuels, engine emission control methods and modern developments in IC engines.

Outcomes:

After completion of the course, students would be able to:

- Understand the working of four-stroke and two-stroke engines and analyze their performance based on air-standard, fuel-air and actual cycles.
- Correlate the effect of engine variables on the combustion process and knocking in SI and CI engines.
- Determine engine output, efficiency and specific fuel consumption and make heat balance sheet and understand engine performance curves.
- Understand the emission control methods, need for alternate fuels and their advantages and disadvantages, and modern developments in IC engines.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction:** Engine nomenclature, four stroke and two stroke engines, spark ignited and compression ignited engines. **Air Standard Engine Cycles and their Analysis**: Brief revision of air standard cycles and their comparison. p-V and T-S diagrams and description. **Fuel air cycles and Actual cycles:** Deviation from air-standard cycles and assumptions made. Effects of losses due to variation of specific heat, chemical dissociation and number of moles. Comparison between air standard, fuel air cycles and actual cycles.	11
2	**Combustion in S.I. engines:** mixture requirements. Simple and modern carburetor. Stages of combustion in S.I. engines, effect of engine variables on ignition lag and flame propagation. Abnormal combustion; knocking, engine variables effecting	06

	knock, surface ignition. S.I. engine combustion chamber design principles. Types of S.I. engine combustion chambers.	
3	**Combustion in C.I. Engines:** Diesel injection systems. Swirl and squish, stages of combustion in C.I. Engines, physical and chemical delay, factors affecting delay, Diesel knock, methods of controlling diesel knock. C.I. engine combustion chambers, Direct injection and indirect injection chambers.	06
4	**Alternative fuels for I.C. Engines**: Use of alcohol, vegetable oils, bio-diesel and bio-gas as alternative I.C. Engine fuels, Fuel blends, comparison with conventional fuels.	03
5	**Engine Cooling**: Need for engine cooling, piston and cylinder temperature distribution. Parameters affecting engine heat transfer. Air cooling and liquid cooling, radiators.	03
6	**Engine testing and performance evaluation**: Engine performance parameters and their measurement, measuring friction power, basic principle of a dynamometer, factors affecting the performance and efficiency of S.I and C.I. Engines. Heat balance sheet. Performance graphs as a function of engine speed. Numerical examples.	06
7	**Tailpipe Engine emissions and control**: Major pollutants from S.I. Engines and C.I. engines. Effect of engine variables on tail pipe emissions. Euro I, II and III norms. Emission control, three way catalytic converters, Exhaust Gas Recirculation (EGR).	04
8	**Modern developments in I.C. Engines**: Supercharging and Turbo charging, Petrol injection, MPFI. CRDI and GDI engines, Stratified charge engines, Rotary engines and Dual fuel and multi-fuel engines.	06
	Total	**45**

Text Books:

1. V. Ganesan (2012), "Internal combustion Engines", 4th Edition, *Tata McGraw Hill.*
2. M.L. Mathur, R.P. Sharma (2004), "A Course in Internal Combustion Engines", Dhanpat Rai *Publications.*

Reference Books:

1. V. L. Maleeve (2000), "Internal Combustion Engines", *Tata McGraw Hill.*
2. J. B. Heywood (1999), "I. C. Engines Fundamentals", International Edition, *McGraw Hill.*

Term Work:

1. Assignments based on syllabus (Min. 3).
2. Minimum six experiments from following list
3. Practical and Viva examination

List of Experiments :

1. Performance of a 4 stroke Diesel Engine and drawing a heat balance sheet
2. Performance evaluation of four stroke petrol engine
3. Performance evaluation of two Stroke Petrol Engine
4. Performance evaluation of multi-cylinder Diesel/Petrol Engine (Morse Test)
5. Valve Timing diagram of an I.C. Engine
6. Determination of Caloric Value of Solid and Gaseous Fuels
7. Performance evaluation of a reciprocating air compressor.
8. Study of following models:

- Carburetor
- Bosch fuel pump
- Wankel engine
- Gas turbine with nozzle (turbojet)

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Program: B. Tech. (Integrated) Mechanical Engineering				**Semester :** VIII	
Course: Finite Element Analysis				**Code :** BTIME08002	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Knowledge of Integral and Vector Calculus (BTIME03004), Differential Equations (BTIME04005)

Objectives:

- To provide the understanding of basics of finite element methods and analysis.
- To impart knowledge of one dimensional and two dimensional Finite element analysis
- To introduce the applications of FEA in structural and thermal domains.

Outcomes:

After completion of the course, students would be able to:

- Understand the basics and mathematical aspect of FEA.
- Formulate the one and two dimensional equations to model engineering problems in structural and thermal fields
- Use FEA software packages for solving complex problems.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction to Finite Element Analysis:** Introduction to FEA, history of FEM, general FEM procedures, applications of FEM in various fields, advantages and disadvantages of FEM and software packages of FEA.	05
2	**Mathematical aspects of FEA:** Newton Cotes formula, Gauss quadrature formula in one and two dimensional, Weak form–Rayleigh-Ritz Method & Non-Weak form Galerkin approach, Finite Difference Method,.	10
3	Types of Finite Elements – 1-D, 2-D and 3-D; Element shape, Interpolation function & Shape function; 1-D element such as two nodded and three nodded bars and beams, Truss element, Finite Element discretization, and application of boundary conditions.	10
4	**One Dimensional Problems:** Element and global stiffness matrix, developing EME and GME; Discretization of domain, introduction to constant strain triangle elements (CST elements) and 2-D plane elements.	12
5	**Application to Field Problems:** Plane trusses, Application with one dimensional and two dimensional Structural and Heat Transfer problems.	8
	Total	**45**

Text Books:

1. J. N. Reddy (2006), "An Introduction to the Finite Element Method", 3rd Edition, *McGraw-Hill Higher Education.*
2. S. S. Rao (2005), "The Finite Element in Engineering", 4th edition *Butterworth Heinemann.*

Reference Books:

1. J. T. Oden and J. N. Reddy (2011), "An Introduction to the Mathematical Theory of Finite Elements", *Dover Publications,*
2. P. Seshu (2010), "Textbook of FEA", *Prentice Hall.*
3. C. S. Desai and J.F. Abel (2000), "Introduction to Finite Elements Methods", *CBS Publications.*

Term Work:

1. Assignments based on syllabus (Min. 3).
2. Viva-voce
3. Practicals based on the following areas
   i. Structural Analysis
   ii. Thermal Analysis

Each exercise shall cover tasks like Model-preparation, Mesh generation, Simulation and Post processing in any analysis software like ABACUS, ANSYS, HYPERMESH, NASTRAN, PRO-E etc

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Program: B. Tech. Integrated (Mechanical)				**Semester:** VIII	
Course: Design of Machine Elements - II				**Code:** BTIME08003	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Engineering Mechanics (BTIME03007), Strength of Material (BTIME04003), Material Engineering (BTIME05003), Theory of Machines – I, II and III (BTIME05001, BTIME06001 and BTIME07006) and Design of Machine Elements – I (BTIME07003).

Objectives:

- To impart the knowledge of design considerations with material selection and functional utility of components.
- To introduce the design concept of simple machine components like, springs, power screws under static load condition based on strength and stiffness criteria.
- To provide the knowledge of different types of bearings and their selection.

Outcomes:

After completion of the course, students would be able to:

- Select appropriate materials for safe design.
- Design of simple machine components like, springs, power screws under static loads.
- Design and select bearing for a given applications from manufacturers catalogue.
- Understand importance of robust design.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Power screws:** Introduction, forms of thread, multiple threads, derivation for torque required to raise load by square threaded screws, torque required to lower load by square threaded screws, efficiency of square threaded screws, maximum efficiency of square threaded screws, overhauling and self-locking screws, efficiency of self-locking screws, coefficient of friction, acme or trapezoidal threads, stresses in power screws (Numerical based on all the above), design of screw jack.	09
2	**Spring design**: Introduction, types of springs, applications and material for springs, stress and deflection equation of helical spring of circular wire, design of helical compression, surge in Springs,	09

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	energy Stored in helical springs of circular wire, spring in series and parallel, design of leaf.	
3	**Sliding Contact Bearing:** Basic modes of lubrications, theory of hydrodynamic lubrication, Pressure development in oil film, hydrostatic step bearing, energy losses in hydrostatic step bearings, Reynolds equation, Somerfield number, Raimondi and Boyd method, Temperature rise, bearing design- selection of parameters, bearing materials, lubricating oils and additives.	10
4	**Rolling Contact Bearing**: Types of rolling contact bearings, selection of bearing type, static and dynamic load carrying capacity, Stribeck's equation, equivalent bearing load, Load life relationship, selection of bearing life, selection of bearing from manufactures catalogue, design for cyclic loads and speeds, bearing with probability of survival other than 90 %, lubrication of rolling contact bearing, mounting of bearing, causes of failure in rolling contact bearings and remedies, use of oil seals.	10
5	**Robust Design:** Concepts of Design for Manufacturing (DFM); Design rules for manufacturing and assembly processes, Design for quality and reliability, weibul distribution, system reliability.	07
	Total	**45**

Text Books:

1. J. F. Shigley (2008), "Mechanical Engineering Design", 8th Edition, *Tata McGraw Hill.*
2. V. B. Bhandari (2010), "Design of Machine Elements", 3rd Edition, *Tata McGraw Hill Publication.*

Reference Books:

1. M. F. Spotts (2004), "Design of Machine Elements", 8th Edition, *Pearson Publication.*
2. M. Tooley (2009), "Design Engineering Manual", *Elesvier, Butterworth - Heine mann.*
3. PSG design data book PSG college-Kalaikathir Achchagam , Coimbatore paperback – 2012

Term Work:

1. Design and preparation of working drawing for screw jack.
2. Assignments based on the above syllabus (Min. 3).
3. Viva Voce Examination

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Program: B. Tech. Integrated (Mechanical)				**Semester:** VIII	
Course: Product Design and Development				**Code:** BTIME08004	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Manufacturing Processes - I (BTIME03001) and II (BTIME04001).

Objective:

- To provide the understanding of the development and design aspects of products.
- To impart knowledge of business and technical concerns about the different methodologies of product development.
- To introduce concept of product life cycle and product data management.

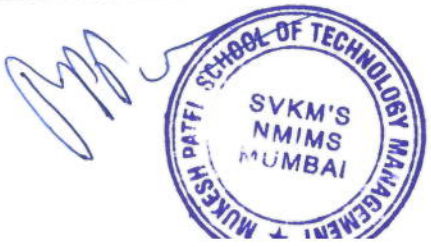
Outcomes:

After completion of the course, students would be able to:

- Understand different stages of product development and design with modern approaches.
- Know the importance of Technology Forecasting using S-Curve in new product development.
- Benchmark products and technologies.
- Understand Product Life Cycle concept and its importance in product development phase.
- Use techniques like QFD and DFX for product design.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction to Product Design and Development:** Definition of product design, design by evolution and innovation, factors in product design, morphology of product design (seven phases), standardization, simplification and specialization in product design, modern approaches-concurrent design and quality function deployment, product development, product development versus product design, types of design and redesign, modern product development process, product development team and product development planning with reference to ISO standard, difference between product verification and production validation, introduction to prototyping, rapid prototyping methods.	12
2	**Product Development – Technical and Business Concerns:** Technology Forecasting and Technology S-Curve (Technology Stage), Mission Statement and Technical Questioning, Economic Analysis of Product, Customer Needs and Satisfaction, Customer Population and Market Segmentation, Customer Needs-Types and Models, Gathering Customer Needs Information, Analysis of Gathered Information.	09



3	**Product Development from Concept to Product Function:** Generating concepts, information gathering and brainstorming, morphological analysis, concept selection-design evaluation, estimation of technical feasibility, concept selection process, Pugh's concept, selection charts, numerical concept scoring, process of concept embodiment, system modeling, Failure Mode Effect Analysis (FMEA), functional modeling and decomposition, fast method, subtract and operate procedure, establishing system functionality, augmentation and aggregation.	12
4	**Quality function deployment (QFD)**: Quality function deployment studies to validate design characteristics; Affinity diagram, Tree diagram, Matrix diagram, Prioritization matrix; Design validation	06
5	**Design for 'X' (DFX):** Design for manufacture, assembly, testing, maintenance, service, reliability; Product safety and hazard evaluation; Final disposal; Reverse Engineering.	06
	Total	**45**

Text Books:

1. K. Otto and K. Wood (2009), "Product Design –Techniques in Reverse Engineering and New Product Development", *Pearson Education*.
2. K. T. Ulrich and S. D. Eppinger (2008), "Product Design and Development", *Tata McGraw Hill*.

Reference Books:

1. R. Rosenthal (2000), "Effective Product Design and Development", *Business One-Irwin S Publication*.
2. E.B. Magrab, S.K. Gupta, F. Patrick (2009), "Integrated Product and Process Design and Development-The Product Realization Process", *CRC press*.

Term work:

1. Assignments based on syllabus (Min. 5).
2. Viva voce/Presentations/Quizzes

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Program : B. Tech. Integrated (Mechanical)				**Semester :** VIII	
Course : Manufacturing Management				**Code:** BTIME08005	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Manufacturing Processes - I and II (BTIME03001 & BTIME04001)

Objectives:

- To develop an understanding of the short and medium term planning and control function of production at middle and operational level.
- To focus on functions for estimation and allocation of resources.
- To impart knowledge of procedures for meeting production and inventory targets in production organizations covering a wide range product type

Outcomes:

After completion of the course, students would be able to:

- Understand the importance of Production Planning and Control in industries.
- Analyze the Break Even chart, P-V Chart, Multiple P-V Chart for economic analysis.
- Evaluate the Project by different techniques like CPM/PERT etc.
- Apply the various techniques to solve the inventory requirements.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Fundamentals of Manufacturing:** Manufacturing definition, Production system, Objectives of Manufacturing Management, functions and scopes of production; Types of production, production interface with other functional areas.	08
2	**Economic Analysis:** Factors to be considered in product design. Production cost concepts; fixed Cost, variable cost, Break Even analysis, P-V chart, and make-buy decision.	07
3	**Plant Location and Plant Layout:** Factors to be considered in plant location, types of Plant layout, process layout. Techniques of plant layout, concept of Group technology, Group layout.	06
4	**Production planning and control:** Objective of PPC, functions of PPC, Capacity planning, manufacturing resource planning and scheduling, JIT system, Kanban pull system of scheduling, line balancing.	07
5	**Materials management:** Bill of materials, Quantity planning, Inventory control, Economic order quantity (EOQ), lead time, consumption rate, different ordering systems, Q system, P system, the store's function and ABC analysis.	08

6	**Introduction to Project management:** Project evaluation and review techniques, critical path method (PERT /CPM), float, three time estimates, probability of completion before due date and optimum duration.	09
	Total	**45**

Text Books:

1. S. Eilon (2007), "Elements of Production Planning and Control", *Universal Publicity Corporation.*
2. S. N. Chary (2009), "Production and Operations Management", *Tata McGraw Hill.*
3. L. S. Srinath (2008), "PERT and CPM – Principles and Applications", *East West Press.*

Reference Books:

1. R. Chase (2008), "Operation Management", *Tata McGraw Hill.*
2. E. S. Buffa (2007), "Modern Production /Operation Management", *Wiley Eastern.*
3. J. S. Matrinich (2008), "Production and Operation Management an Applied Modern Approach", *Wiley India.*

Any other information :

Term Work:

1. Assignments given by the faculty based on above syllabus (Min. 3).
2. Individual/Group presentation pertaining to topic selected from the syllabus content.

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Program: B. Tech. Integrated (Mechanical)				**Semester :** VIII	
Course : Mechatronics				**Code :** BTIME08006	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Elements of Electrical Engineering (BTIME02008), Industrial Electronics (BTIME05002), Fluid Mechanics (BTIME05004)

Objectives:

- To understand the principles of a multi-disciplinary approach in the development of efficient and productive Mechatronics systems.
- To study the basics of fluid power system and develop simple hydraulic and pneumatic systems.
- To describe the building blocks of a PLC systems and building construction of Ladder logic

Outcomes:

After completion of the course, students would be able to:

- Apply the knowledge of various sensors and actuators and apply them in the development of simple mechatronics system
- Develop basic hydraulic and pneumatic circuits for industrial applications
- Construct simple Ladder Logic diagram to be used in modern automation industries.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction:** Definition of mechatronics, Mechatronics in modern manufacturing, products and design, Comparison between Traditional and Mechatronics approach, Elements of Mechatronics system.	05
2	**Sensors:** Significance of Sensor Measurements, Classification of Sensors, Analog vs Digital Sensors, Sensors for displacement, strain, pressure, temperature, acceleration, Proximity Sensors, Ultrasonic Sensors. Optical sensors, Smart sensors.	07
3	**Actuators in Mechatronics Systems:** Linear motion drives. Electrical actuators - DC Motors, Stepper Motors, Servo motors, Induction Motors, Hydraulic and Pneumatic actuation. Selection of actuators.	06
4	**Fundamentals of Fluid Power Systems:** History of fluid power transmission, Pascal's law, ISO symbols of fluid power elements,	04
5	**Elements of Fluid Power System:** Hydraulic pumps, Hydraulic power pack, directional control valves, flow control valves, pressure control valves, check valves, Accumulators, Air compressors, FRL unit.	05
6	**Design of Hydraulic and Pneumatic Circuits:** Design of typical hydraulic circuits - regenerative circuit, Meter in and meter out circuit, sequence circuit, Bleed-off circuits, Counter balancing circuits,	08

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	Development of single and multiple actuator circuits, Sequencing circuits using Electropneumatics/ Electrohydraulic.	
7	**Programmable Logic Controllers:** Basic building block and function, advantages over hard-wired control, Programming of PLC, Ladder logic diagram, PLC timers and counters, Simple ladder logic problems.	10
	Total	**45**

Text Books:

1. Bolton, W. (2008), "Mechatronics: A Multidisciplinary Approach", (Vol. 10). *Pearson Education.*
2. Alciatore, D. G., Histand, M. B., & Alciatore, D. G. (2007), "Introduction to Mechatronics and Measurement Systems", *Tata McGraw-Hill Education.*

Reference Books:

1. Shetty, D., & Kolk, R. (2010), "Mechatronics System Design", *SI Version. Cengage Learning.*
2. Norman Nise, John Wiley and Sons (2004), "Control System Engineering", *John Wiley & Sons*
3. Braga N. C. (2003), "Mechatronics Sourcebook", Thomson Delmar Learning, *Eswar Press.*

Term Work:

1. Minimum 8 Experiments from the list of experiments
2. Industrial Visit and report.
3. Mini-project and/or case studies

List of Experiments:

1. Study of capacitive, inductive proximity and ultrasonic sensors.
2. Study of Hydraulic and Pneumatic system components.
3. Design of simple hydraulic circuit using linear actuator and hydraulic motor.
4. Design of meter-in and meter-out circuit.
5. Design of Continuous Cycle Circuit.(Pneumatic)
6. Design of Electro Pneumatic Sequential Circuit.
7. Design of Sequential Circuit Using Cascade Method.
8. Design and Simulation of Various Fluid Power Circuits Using Automation Studio Software / FluidSIM Software.
9. Development of simple Ladder logic for industrial application.

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SVKM's Narsee Monjee Institute of Management Studies

Mukesh Patel School of Technology Management & Engineering

Program: B. Tech. Integrated (Mechanical)				**Semester:** IX	
Course: Refrigeration and Air Conditioning				**Code:** BTIME09001	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Engineering Thermodynamics (BTIME03002), Thermal Engineering (BTIME06004), Heat Transfer (BTIME07001)

Objectives:

- To impart the knowledge of working of vapour compression and vapour absorption refrigeration systems.
- To provide the understanding of different processes in psychrometry used in air-conditioning, and introduce cooling load calculations
- To introduce duct design methods.
- To introduce the applications of refrigeration and air conditioning.

Outcomes:

After successful completion of the course, the students should be able to

- Understand the working of vapour compression refrigeration system and indicate it on T-s and p-h diagrams and calculate its COP.
- Know the properties of refrigerants and binary mixtures and understand the working of different vapour absorption systems and evaluate their performances
- Represent different air-conditioning processes on psychrometric chart and design air–conditioning systems as per cooling load.
- Design of ducts for air-conditioning.
- Understand the refrigeration requirements for applications such as food processing and preservation and air-conditioning requirements for industrial and commercial applications.

Detailed Syllabus

Unit	Description	Duration
1	**Introduction To Refrigeration:** Methods of refrigeration, Carnot refrigerator, Carnot heat pump, co-efficient of performance(COP), unit of refrigeration(TR), Energy efficiency ratio(EER) Air-craft refrigeration systems; Need for air-craft refrigeration and Simple air-cooling system.	05
2	**Vapor Compression Refrigeration System:** Simple vapor compression cycle (VCC); T-s, h-s and p-h diagrams for VCC, COP calculation from T-s and h-s charts for different conditions, Theoretical and actual cycle, Wet versus dry compression, pressure losses and their effects on the VCC, Effect of suction and delivery pressure on VCC. Vapor compression refrigeration (VCR) systems with multiple evaporators and compressors.	08

3	**Absorption Refrigeration System:** Ammonia-water vapor absorption refrigeration (VAR) system. Enthalpy- concentration, analysis of the system. Lithium bromide-water absorption refrigeration system, Introduction to Electrolux refrigeration system.	05
4	**Refrigerants:** Desirable properties of refrigerants, designation system for refrigerants, thermodynamic, chemical and physical properties, secondary refrigerants, selection of refrigerants, ODP, GWP and TEWI	03
5	**Psychrometry and Air – Conditioning:** Psychrometric properties, Dalton's law of partial pressure, chart and processes, psychrometer, By-pass factor, Apparatus dew point temperature, Human comfort- Requirement of comfort air conditioning, thermodynamics of human body, effective temperature, comfort chart, comfort zone, economic considerations for selecting the comfort points Mixing process, basic processes in conditioning of air, psychrometric processes in air conditioning equipment, Different classes of air conditioning system, summer air-conditioning, winter air conditioning. Cooling load calculations.	15
6	**Duct Design** Friction chart for circular ducts. Equivalent diameter of a circular duct for rectangular ducts. Static pressure regain and equal pressure drop methods of duct design. Fans and blowers. Introduction to AHU-design/selection.	06
7	**Applications of Refrigeration:** Food processing and preservation, typical examples of food processing by refrigeration and storage, transport refrigeration. **Applications of Air Conditioning:** Industrial, commercial, residential hospital requirement and transport.	03
	Total	**45**

Text Books:

1. Prasad Manohar (2017), "Refrigeration and Air Conditioning" 2nd Edition. *New Age International.*
2. Ahmadul Ameen(2006), "Refrigeration and Air- Conditioning " Prentice Hall of India

Reference Books:

1. Ashrae, "Handbook: Heating, Ventilating and Air Conditioning Applications" (2010), American Society of Heating, Refrigerating and Air Conditioning Engineers.
2. Arora C. P. (2009), "Refrigeration and Air Conditioning", 3rd Edition, *Tata McGraw Hill.*

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3. S.K. Bose (2005),"Refrigeration and Air- Conditioning " Allied Publishers
4. Ananthanarayanan P. (2013): Basic Refrigeration and air-conditioning, 4th Edition, *Tata McGraw Hill Publication.*

Term Work:

1. Assignments given by the faculty based on the syllabus (Min 3).
2. Experiments as per the list provided
3. Viva voce

List of Experiments

1. **Performance evaluation of following test rigs**
   a. Refrigeration cycle test rig
   b. Air conditioning test rig
   c. Ice plant test rig
   d. Water cooler test rig.
2. **Study of following models:**
   a. Evaporator cooler equipment
   b. Cut section-compressor
   c. Refrigerator
   d. Thermostatic Expansion valve
   e. Cut section – solenoid valve

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Program: B. Tech. Integrated (Mechanical)				**Semester:** IX	
Course: Design of Machine Elements - III				**Code:** BTIME09002	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Engineering Mechanics (BTIME03007), Strength of Material (BTIME04003), Material Engineering (BTIME05003), Theory of Machines – I, II and III (BTIME05001, BTIME06001 and BTIME07006) and Design of Machine Elements – I (BTIME07003). Design of Machine Elements – II (BTIME08003)

Objectives:

- To understand design of transmission systems used in the industry.
- To explain design of gear and gear systems used in the industry.
- To provide the knowledge of different types of belts and their selection.

Outcomes:

After completion of the course, students would be able to:

- Select appropriate materials and gears for industrial applications
- Design of gears under static and dynamic loads.
- Design of belts and Selection of belt from Manufacturer's catalogue.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Gear Design:** Types of gear and its applications, selection of gear materials with desirable properties, modes of Gear tooth failure and methods of gear lubrication.	05
2	**Design of Spur Gear:** Terminology, minimum number of teeth, face width and module relation, force analysis, beam strength of gear tooth (Lewis Equation), Velocity factor, service factor, effective load on gear tooth, Wear Strength of of gear tooth (Buckingham Equation), Module calculation based on beam and wear strength.	08
3	**Design of Helical Gear:** Terminology, transverse and normal module, Virtual number of teeth, tooth proportions, force analysis, beam and wear strength, effective load on gear tooth	08
4	**Design of Bevel Gears:** Types of Bevel gears, terminology of straight tooth bevel gear, formative number of teeth, force analysis, beam and wear strength, dynamic load and effective load, materials selection for straight bevel gear, introduction to spiral bevel gear.	05
5	**Design of Worm Gear:** Terminology, geometric proportions of worm gears, force analysis, friction in worm gears, efficiency	04

	of worm gears, material selection, strength rating of worm gears, wear rating of worm gears, thermal considerations	
6	**Design of Belt drives:** Flat Belt Drive: Belt Construction, Flat Belt Drive: Length of the Belt: Open and cross belt drive. V Belt drive, Ribbed V Belt. Analysis of belt tensions, Condition for maximum power transmission. Creep phenomenon. Selection of Flat belt and V belt from Manufacturer's catalogue. Pulleys for Flat belts and V belts. Belt tensioning devices.	15
	Total	**45**

Text Books:

1. V. B. Bhandari (2017), "Design of Machine Elements", 4th Edition, *Tata McGraw Hill Publication.*
2. J. E. Shigley and C.R. Mischke (2014), "Mechanical Engineering Design" *McGraw Hill Publication Co. Ltd.*

Reference Books:

1. M. F. Spotts and T. E. Shoup (2008), "Design of Machine Elements", *PrenticeHall International.*
2. V. M. Faires (2008), "Design of Machine Element", *McMillan.*
3. V.B.Bhandari (2014) "Machine Design Data Book", *McGraw Hill Education (INDIA) PVT. Ltd.*
4. PSG design data book PSG college- Kalaikathir Achchagam , Coimbatore paperback – 2012

Term Work:

1. Design of Two stage Gearbox with fixed ratio consisting of gear. pairs, Gear box Housing, Housing layout and housing design
2. Assignments based on the above syllabus (Min. 3).
3. Viva Voce Examination

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Program: B. Tech (Mechanical Engineering)				**Semester:** IX	
Course: Additive Manufacturing				**Code:** BTIME09003	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Manufacturing Processes I and II (BTIME03001 & BTIME04001), Machine Drawing (BTIME04002), CAD/CAM/CIM (BTIME07002)

Objectives:

- Acquire introductory knowledge of Additive Manufacturing and applicability of AM in modern customer-oriented manufacturing industry.
- To get acquainted with the operating principles of most prominent technologies in the field of Additive Manufacturing.
- Finding the common software issues associated with AM and addressing it using file repair algorithms.

Outcomes:

After completion of the course, students would be able to:

- Understand the importance of Additive Manufacturing and identifying various industrial sectors where it can be applied.
- Include AM as a critical tool in the product design cycle and to rapidly develop prototypes, thereby reducing the lead time
- Understand and operate FDM 3D Printers.
- Identify enterprising opportunities in the field of Additive Manufacturing.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction to Additive Manufacturing (AM):** Introduction to AM, History of AM, Why use the term Additive Manufacturing, Distinction between AM, CNC & other digital manufacturing techniques, Advantages of AM, Classifications of AM processes. Design for Additive Manufacturing (DFAM)	03
2	**Additive Manufacturing Process Chain:** Basic eight steps in AM Process Chain, 3D Modelling, Data Conversion and Transmission, Checking and Preparing, Building, Post processing, Application.	07
3	**Liquid-Based Processes:** Introduction, Photo-polymerization-Basic overview, Stereolithography (SL) Process overview, Other liquid-based processes: Solid Ground Curing (SGC), Solid Creation System (SCS), Solid Object Ultraviolet-Laser Printer (SOUP), Rapid Freeze Prototyping, Microfabrication.	07

4	**Powder Bed Fusion Process:** SLS process overview, Powder fusion mechanism, Powder handling, Metal and Ceramic powder processing, Other powder based processes- EOSINT Systems, Three-Dimensional Printing (3DP), Laser Engineered Net Shaping (LENS), Direct Shell Production Casting (DSPC), Multiphase Jet Solidification (MJS), Electron Beam Melting (EBM).	08
5	**Extrusion-Based Processes:** Fused deposition modelling, Basic principle and process, FDM machines type, Materials used in FDM, Other extrusion based processes-Multi-Jet Modelling System (MJM), Contour Crafting, Nonplanar System, FDM of Ceramics,	07
6	**Software Issues for Additive Manufacturing:** Conversion of CAD model into STL file, Issues with STL file, STL file manipulation, Other Translators, Newly Proposed Formats.	07
7	**Applications and Examples:** Medical application, software for medical application, Applications in Design, Aerospace Industry, Automotive Industry, Biomedical Industry, Jewelry Industry.	03
8	**Business Opportunities in Additive Manufacturing:** Product Development, Product Evolution, Supply Chain Evolution, Business Model Evolution, Digipreneurship,	03
	Total	**45**

Text Books:

1. **Gibson I, Rosen D W, Stucker B** (2010), "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", *Springer.*
2. **Chua, C. L., Lim, K.,** (2003), "Rapid Prototyping: Principles and Applications", *World Scientific Publishing Co. Pte. Ltd.*
3. **Noorani, R.** (2006), "Rapid prototyping: Principles and Applications", *John Wiley & Sons Incorporated.*
4. **Kamrani, A. K., & Nasr, E. A.** (2006), "Rapid prototyping: theory and practice", (Vol. 6), Springer *Science & Business Media.*

Reference Books:

1. **Pham, D., & Dimov, S. S.** (2012), "Rapid manufacturing: the technologies and applications of rapid prototyping and rapid tooling", *Springer Science & Business Media.*
2. **Gebhardt, A., & Gebhardt, A.** (2012), "Understanding Additive Manufacturing", *Hanser Publications*

Term Work:

1. Mini Project and/or Case Studies
2. Experiments as per the list provided (min 8)
3. Industrial Visit and report

List of Experiments:

1. Review of CAD Modelling Software packages (AutoCAD, CATIA, SOLIDWORKS, CREO or any other suitable package) and modelling of 3D model using any one software.

2. Understanding the working of Leapfrog Creator FDM 3D printer and its software interface.
3. Processing the CAD data in Repeater software or Slicer (Selection of Orientation, Supports generation, Slicing, Tool path generation).
4. Understanding the properties of various plastic filament used in FDM printers
5. Fabricating the 3D models on FDM RP machine
6. Fabricating the 3D models with and without supports
7. Working with CAD Data Exchange formats: IGES, ACIS, DXF and STL
8. Identification of STL file problems using MAGICS software repairing the models
9. Converting CT/MRI scan data into STL file using MIMICS software (Demo)
10. Studying the machinability properties of 3D printed parts.

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Program: B. Tech. Integrated (Mechanical)				**Semester:** IX	
Course : Project Part - I				**Code:** BTIME09004	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**	**Theory (------)**
0	6	0	3	Scaled to 50 marks	-

Pre-requisite: All Mechanical Engineering subjects till semester VII

Objectives:

- To inculcate the ability to gather information for the seminar topic with presentations and report

Outcomes :

After completion of the course, students would be able to:

- Apply the use of knowledge of basic Mechanical Engineering subjects
- Carry out literature review for the seminar topic
- Develop presentation and communication skills

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	Each student will select a topic in the area of Mechanical engineering and related area in the state of art area and technical development, The topic will be decided by the student, guide and departmental research committee. Literature collection related to the topic selected by individual student. Objective should be defined before end of Semester.	06
	Total	**06**

Internet References: As prescribed by Faculty

Detail guidelines for the project:

Project – Phase 1 Activities to be done:

1. The Project group to be formed consisting of not more than 4 students.
2. The project area and topic is to be selected in consultation with Project Mentors, alternatively students can propose the topics.
3. The names of the students and the topic of the project to be submitted in the first week of Semester along with name of the Mentor.

4. The first phase of the project will involve Literature Survey and feasibility study.
5. Student is required to submit a 1-2 pages weekly report on the work done to the Mentor. Attendance will be given on the report. There would continuous evaluation based on the weekly report submitted for 50 marks.
6. Report primarily containing Literature Survey and feasibility study is to be submitted at the end of the Semester. (Spiral Bound Report)
7. Presentation (About 30 minutes) of the work done during the Semester to be evaluated by Internal Examiner and Project Mentor.

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Program: B. Tech. Integrated (Mechanical)				**Semester:** IX	
Course: Elective I - Renewable Energy Sources				**Code:** BTIME09005	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Engineering Thermodynamics (BTIME03002), Knowledge of Engineering Physics (BTIME04006), Thermal Engineering (BTIME06004)

Objectives:

- To provide the understanding of basics energy scenario and need for non conventional energy sources.
- To make students familiarize with different non-conventional energy sources and their use.
- To motivate students to work on non-conventional energy tapping techniques.

Outcomes:

After completion of the course, students would be able to:

- Understand the global energy crisis and need for alternative energy sources.
- Understand the techniques to harness non-conventional energy sources – solar, wind, geothermal, biomass, ocean and chemical.
- Understand the working of devices such as solar heaters, photovoltaic cells, wind turbines, biogas plants and fuel cells etc.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Energy Requirement – of India and World:** Present energy scenario, conventional energy sources- World's production and reserves, India's production and reserves. Global energy crises, shortcomings and limitations to the existing energy sources, need for alternative energy sources.	03
2	**Solar Energy:** Solar radiation- Terrestrial and extraterrestrial. Energy potential of sun, simple flat plate collector, design of liquid flat plate collector, selective coatings, Application of LFPC performance, analysis of LFPC. Concentrating collectors, solar ponds, solar distillators, solar satellite power system, solar cooker, solar air heaters, solar driers, photovoltaic direct energy conversion, solar cells, solar thermal power system, solar energy storage.	10
3	**Wind Energy:** History, principle of wind power, Betz model, wind mills- horizontal axis and vertical axis, horizontal axis wind turbines, their components.	08

	Operation, recent developments and their site characteristics. Vertical axis- Magnus effect, Madaras and Darrieus turbine. Application of wind energy.	
4	**Geothermal Energy:** History and future, origin and types of geothermal energy regions, dry rock and hot Aquifer analysis, vapor dominated and liquid nominated geothermal systems, operational and environmental problems.	05
5	**Ocean Energy:** Types of ocean energy sources, Ocean temperature difference, OTEC cycles-closed and open. Comparison with normal thermal power cycles. Ocean waves-Wave motion, Energy power from waves, Wave energy Conversion devices. Tidal Power-Formation and causes of tides, power from tides, Tidal power devices.	07
6	**Biomass Energy:** Various forms of biomass as a potential energy source, energy plantation, Bio-fuel production processes, Biogas plants, Gassifiers, principle, construction and design of gassifiers, individual and community bio and gobar gas plants, Types of gobar gas plants.	06
7	**Chemical Energy Sources:** Fuel cells-principle, classification, advantage and disadvantage, application and recent development	06
	Total	**45**

Text Books:

2. John W. Twidell and Anthony D. Weir (2006), "Renewable Energy Sources", 2nd Edition, *Taylor and Francis.*
3. G. D. Rai (2009), "Non-Conventional Energy Sources", *Standard Publisher.*

Reference Books:

1. G. N. **Tiwari** and M. K. **Ghosal** (2005), **"Renewable Energy Resources**: Basic Principles and Applications", ***Narosa*** Publishing House.
2. S. P. Sukhatme, J. K. Nayak (2008), "Solar Energy - Principle of Thermal Collection and Storage", *Tata McGraw Hill.*
3. P. H. Henderson (2005), "India-The Energy Sector", *Oxford university Press.*
4. D. A. Ray (2000), "Industrial Energy Conservation", *Pergamon Press.*

Term Work:

1. Assignments given by the faculty based on above syllabus (Min. 3).
2. Viva voce

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Program: B. Tech. Integrated (Mechanical)				**Semester:** IX	
Course: Elective I - Advanced Turbomachinery				**Code:** BTIME09006	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Engineering Thermodynamics (BTIME03002), Fluid Mechanics (BTIME05004) and Heat Transfer (BTIME07001)

Objective:

- To provide the understanding of principles of turbomachinery.
- To impart the knowledge of different types of turbomachines their industrial applications.

Outcomes:

After completion of the course, students would be able to:

- Demonstrate the principle of energy transfer in turbomachines.
- Draw velocity triangles at inlet and exit for different kinds of machines and apply the same towards solving the problems,
- Understand the principles of impulse, reaction, utilization factor etc. in turbines.
- Analyze performance characteristics of turbo machines

Detailed Syllabus: (per session plan)		
Unit	**Description**	**Duration**
1	**Principles of turbomachinery:** The positive displacement machines and turbomachines, classification of turbo machines- according to fluid handled, according to direction of fluid flow, according to specific speed, impulse and reaction machine energy transfer in turbomachines, Euler's equation, degree of reaction, utilization factor. **Thermodynamic analysis of compression and expansion process:** static and stagnation states; application of first and second laws to turbomachines, work and efficiencies in compression and expansion processes.	12
2	**Analysis of centrifugal machines:** Compressor, fan, blower construction, working, performance characteristics pump construction, working, performance characteristics turbine construction, working, performance characteristics, multistaging	10
3	**Analysis of axial flow machines:** **Compressor**: fan, blower, construction, working, performance characteristics **Pump:** Construction, working, performance characteristics	10

	Turbine: Construction, working, performance characteristics Multistaging	
4	**Testing and control of fans:** Fan testing, noise control, materials and components, blower regulations, speed control, throttling control at discharge and inlet.	05
5	**Design aspects of turbo machines**: Compressor, fan and blower. Industrial applications of compressor, fan and blower	08
	Total	**45**

Text Books:

1. S. M. Yahya (2011), "Turbines, Compressors and Fans", *Tata McGraw Hill.*
2. V. Kadambi and M. Prasad (2010), "An Introduction to Energy Conversion, Volume 3 – Turbomachinery", *New Age International Publishers.*

Reference Books:

1. D. G. Shepherd (1969)(Classic), "Principles of Turbomachinery", *Macmillan,*
2. W. W. Peng (2008), "Fundamentals of Turbomachinary", *John Wiley.*
3. V. Ganesan (2010), "Gas Turbines", 3rd Edition, *Tata McGraw Hill.*

Term Work:

1. Assignments covering syllabus (Min. 3).
2. Numerical examples on unit 1, 2, 3 and 5.

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Program: B. Tech. Integrated (Mechanical)				**Semester :** IX	
Course: Elective I - Automobile Engineering				**Code:** BTIME09007	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Theory of Machines - II (BTIME06001), I. C. Engine (BTIME08001), Design of Machine Elements - I and II (BTIME07003 and BTIME08003)

Objective:

- To impart the knowledge of the basics of the automobiles.
- To introduce the different automobile systems like suspension, axles and steering and transmission systems in the Automobiles.
- To introduce the different electrical system, charging system, starting system and electronic control module, electronic spark control, electronic fuel injector and electronic sensors in automobile

Outcomes:

After completion of the course, students would be able to:

- Understand the types of engines used in automobile and their characteristics, selections of suitable rear axle, gear etc.
- Analyze the chassis layout, steering geometry, types of suspensions, and drive mechanism of vehicle.
- Understand the different electrical system, charging system, starting system and electronic control module, electronic spark control, electronic fuel injector and electronic sensors in automobile

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Vehicle Performance:** Types of engines used in automobiles, their characteristics and selections, resistance to motion of vehicle, air, rolling and gradiant resistances, power requirement for acceleration and tradability, selection of suitable rear axle and gear ratios.	06
2	**Chassis:** Chassis layout, power plant location, types of automobiles, weight distribution stability, type of frame, materials.	03
3	**Steering:** Steering geometry, wheel alignment and wheel balancing, center point Steering, Ackerman and Davis steering, cornering force slip angle, scrub radius, steering conventional layout of steering system. steering systems for independent suspension, wheel wobble and shimmy, power steering. **Axle:** Axle material, load and stresses on front axle design, steering heads, axle bearing wheel alignment, rear axle arrangements, two speed rear axle, single, double and triple reduction rear axles.	12

	Drive line: Propeller shafts and universal joints, types and construction, different types of universal joints and constant velocity joints. **Live axle and differential:** Final drive, spiral, bevel, hypoid, and worm drives, Types of live axles, semi, three quarter and full floating axles, Necessity of differential, conventional and non slip differential, Trouble shooting and remedies	
4	**Suspension System:** Objects of suspension, Basic requirements, Springs- leaf and coil spring, Air suspension and its feature, Independent suspension, Forces acting in independent suspension, sprung and un-sprung mass, pitching, rolling and bouncing, shock absorbers. **Wheel and Tyres:** Requirements of wheels and tyres, constructional features, Types of tyres, Inflation pressure and its importance, application to ride and stability, trouble shooting and remedies	06
5	**Electrical system:** Battery: Types of battery, lead acid, Alkline, ZEBRA, sodium sulphur and swing, ratings, charging, maintance and testing of lead acid battery Electronic Ignition System: Capacitor, Discharge ignition system, Distributor less ignition system, Direct ignition system, Hall effect pulse generator, Inductive pulse generators, constant dwell system, constant energy system. Charging system: Dynamo: Principle of operation, construction, working, Regulators, combined current and voltage regulators. Alternator: Principle of operation, construction, working, rectification from AC to DC Starting system: Requirements, various torque terms used, starter motors drives, Bendix, Follo through, Barrel, Rubber compression, compression spring, friction clutch, overrunning clutch, Dyer, starter motor solenoids and switches, glow plugs	10
6	**Recent trends in Automobiles:** Electronic control module (ECM), operating modes of ECM (closed loop and open loop), Input required and output signals from ECM, electronic spark control, Air management system, Idle speed control, Multipoint fuel injection system and single point fuel injection, Electronic fuel injectors, principle of operation, construction, working and application of temperature sensors, inductive sensors. Position sensors(rotary, linear), pressure sensors, knock sensors, Hot wire and thin film air flow sensors, vertex flow/turbine sensors, optical sensor, oxygen sensors, light sensors, methanol sensors, rain sensor, New development in sensors technology	08
	Total	**45**

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Text Books:

1. K. K. Jain and Asthana (2002), "Automobile Engineering", *TTI Publications.*
2. R.K. Rajput (2007), "A Text Book of Automobile Engineering", *Laxmi Publications.*
3. S. Kripal (2009), "Automobile Engineering Vol I", *New Chand Jain.*
4. William Cruose, Donald L Anglin (2007), "Automotive Mechanics", *McGraw Hill.*
5. Joseph Heitner (2006), "Automotive Mechanics", *CBS Publisher and Distributors.*

Reference Books:

1. G. Genta, Morello (2009), "The Automotive Chassis: System Design", *Springer.*
2. Society of Automotive Engineering (1997), "Automotive Engineering".
3. D. Crolla (2009), "Automotive Engineering: Powertrain, Chassis System, Vehicle, Body", *Butterworth- Heinemann.*
4. Tom Denton (2012), "Automobile Electrical and Electronics", *Taylor and Francis Group.*
5. Dick King, Steve V. Hatch (2004), "Conputerised Engine control",
6. Light and Heavy Vehical technology (2016), M. J. Nunney.

Term Work:

1. One assignment from each unit.
2. Experiments (any 5) from the list given below
3. Study of Engines, systems and mechanisms of vehicles with sketches and write ups.
4. Viva Voce /Presentations

List of Experiments:

1. Study of Chassis Layout.
2. Study of engine components
3. Study of Power plant location and mounting.
4. Study of Steering mechanism and Power Steering.
5. Experiment on Suspension system (coil spring and leaf spring) mounting and design calculations.
6. Study of Universal joint and differential mechanism.
7. Study of ignition and charging system
8. Study of starting system, lighting system and battery
9. Study of computer control engine

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Program: B. Tech. Integrated (Mechanical)				**Semester:** IX	
Course: Elective I – Introduction to Nano-Technology				**Code:** BTIME09008	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Materials Engineering (BTIME05003)

Objectives:

- To provide the understanding of new areas of nano-materials.
- To impart the knowledge of various measurement techniques for the nano-materials
- To generate interest of students and introduce the students to the new areas of upcoming research

Outcomes:

After completion of the course, students would be able to:

- Understand the basics of nanotechnology and its applications in various fields of science and engineering
- Learn new techniques of nano size measurement like SEM, TEM etc
- Venture into the new areas of research like fuel cells, solar cells etc

Detailed Syllabus: (per session plan)		
Unit	**Description**	**Duration**
1	**Basic Solid State Physics**: Crystal structures, size dependence of properties, semiconductors, energy bands, excitations.	06
2	**Measurement of properties**: particle size, TEM, SEM, STM, AFM, Spectroscopy and magnetic resonance Properties of individual nanoparticles – Metal nanocrystals, magic numbers and theoretical modeling, geometric structure, semiconducting nanoparticles, carbon nanoparticles.	08
3	Synthesis and characterization Bulk nanocrystals- synthesis methods thin film deposition, multilayers, magnetic nanoparticles, spin valve, giant and colossal magnetoresistance, ferrofluids Quantum wells, wires and dots	08
4	Carbon nanostructures, carbon molecules, carbon clusters, carbon nanotubes: Fabrication, structure, Electrical properties, vibration properties, Mechanical properties. Application of carbon Nanotubes; Field emission and shielding, Computers, Fuel cells, Chemical sensors, Catalysis, Mechanical Reinforcement.	08
5	Organic compounds and polymers-forming and characterization, size effects, supramolecules, micelles Biological materials – biological building blocks, DNA double nanowire, genetic code, biological nanostructures (proteins, miscelles and vescilles), multilayer films,	07

	Unsteady One-dimensional Flow Two and Three-dimensional Situations Over relaxation and Under relaxation	
5	**MEMS, NEMS**: design, fabrication and applications. (Nanostereolithography, Plasma CVD), coating of nanoparticles.	08
	Total	**45**

Text Books:

1. Charles P Poole Jr. and Frank J Owens, "Introduction to Nanotechnology", *Wiley*
2. Hari Singh Nalwa (Editor), "Nanostructured Materials and Nanotechnology" *Concise Edition, Academic.*
3. William A Goddard, Donald W Brenner, Sergey Edward Lyshevski, Goddard III, "Handbook of Nanoscience, Engineering, and Technology", *CRC Press.*

Reference Books:

1. David Sellmyer and R Skomski Ed., "Advanced Magnetic Nanostructures", *Springer.*
2. Gabriel O Shonaike, Suresh G Advani, "Advanced Polymeric Materials" *CRC Press.*

Term Work:

1. Assignments given by the faculty based on above syllabus (Min. 3).
2. Viva Voce

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Program: B. Tech. Integrated (Mechanical)				**Semester:** IX	
Course: Elective I- Project Management				**Code:** BTIME09009	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Prerequisite: Nil

Objectives:

- To introduce aspects of project management such as formulation, planning, scheduling and control of project.
- To provide with a high level overview of project management.
- To impart knowledge associated with planning, budgeting, scheduling, controlling, and terminating a project.

Outcomes :

After completion of the course, students would be able to:

- Understand the process of Project Management.
- Create a work breakdown structure with specifications
- Apply cost estimating and budgeting methods to a project
- Identify important risks facing a new project.
- Apply appropriate techniques to assess ongoing project performance.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction to project management**: Definition, Function, evolution of project management , classification of project management in different environments	03
2	**The project management systems, methodologies and systems development cycle**: Scope, systems approach, project feasibility, project life cycle, the phases of systems development cycle.	04
3	**Project Planning**: Planning fundamentals, project master plan, work breakdown structure and other tools of project planning, work packages project organization structure and responsibilities, responsibility matrix.	06
4	**Project Scheduling**: Use of Gantt charts and network diagrams, activity of node diagrams, activity on arrow diagrams the critical path, time based networks.	04
5	**PERT, CPM, Resource Allocation Introduction to** Tools and techniques for scheduling development, crashing of networks, time-cost relationship, Resource leveling multiple project scheduling.	05

6	**Cost Estimating and Budgeting**: Cost estimating process elements of budgeting, Project cost accounting and management information systems, cost schedules and forecasts.	05
7	**Managing Risks in Projects**: Risk concepts and identification, risk assessment, risk priority, risk response planning, risk management methods.	04
8	**Project Control**: Information monitoring, internal and external project control, cost accounting systems for project control, control process, performance analysis, variance limits, issues in project management software (MS Projects).	05
9	**Project Evaluation, Reporting and termination:** Project reviews and reporting, closing the contract.	04
10	**Project organization structure and integration** :Requirement of project organizations, different structure and integration in large scale projects, roles of project manager and project team	05
	Total	**45**

Text Books:

1. John M. Nicholas (2001), "Project Management for Business and Technology", 2nd Edition, *Pearson Education Asia.*
2. Jack R Meredith, Samuel J Mantel (2011), "Project Management –A Managerial Approach", 8th Edition, *JW and Sons.*

References Books:

1. Dennis Lock (2013), "Project Management", 8th Edition.
2. Norman R Howes (2001), "Modern Project Management", *Amacom.*
3. Prasanna Chandra (2014), "Projects: Planning, Analysis, Selection, Financing Implementation and Review", 8th Edition, *Tata McGraw Hill.*
4. Gido, Rose Baker and Clements (2017), "Successful Project Management", 7th Edition, *Thomson.*
5. Choudhury (2006) "Project Management", *Tata McGraw Hill.*

Term Work:

1. Assignments based on the syllabus (Min 3).
2. Seminar or Presentation on topic based on syllabus.
3. Viva Voce

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SVKM's Narsee Monjee Institute of Management Studies

Mukesh Patel School of Technology Management & Engineering

Program: B. Tech. Integrated (Mechanical)				**Semester :** X	
Course: Total Quality Management				**Code:** BTIME10001	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	0	3	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Knowledge of Industrial Engineering (BTIME07004), Manufacturing Management (BTIME08005).

Objectives:

- To explain the concepts and strategies for implementing and managing quality toward satisfying/delighting the customer
- To facilitate an understanding of the fundamentals of TQM, SPC, Quality Engineering and Six Sigma methods

Outcomes:

After completion of the course, students would be able to:

- Understand the principles of TQM.
- Apply the concepts of Statistical process control.
- Utilize the tools and techniques of TQM.
- Explain various Quality Management Systems.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction:** Fundamentals of TQM – Historical developments – important philosophies- (Deming, Juran, Crossby) and their impact of quality – Quality planning, Quality statement – TQM implementation stages Leadership: Vision/Mission/strategy	07
2	**Principles of TQM**: Customer satisfaction – customer perception of quality, Costs of Quality, customer complaints, Employee involvement – Juran Trilogy, PDSA cycle, 5S, Kaizen	06
3	**TQM Techniques:** Quality Functions Deployment (QFD) – house of Quality, QFD process and benefits, Benchmarking process, TPM – Concepts, FMEA – concept, stages , Quality Circle	06
4	**Quality Management System**: ISO 9001-2000- Elements, Implementation, Documentation and Auditing. ISO14000 – Concept requirements and benefits – Case studies.	06
5	**Statistical Process control:** Seven tools of quality, Statistical fundamentals – Accuracy and precision, Normal curve charts for variables and attributes, Introduction to Control Charts- Control charts for variables,	10

	Process capability Analysis, Control charts for attributes	
6	**Experimental Design:** ANOVA, Full Factorial Experiments, Orthogonal Experiments. **Quality Engineering and Robust Design:** Taguchi Loss functions, Objective robust design, case study. **Six Sigma:** Principles, DMAIC framework for quality improvement, Implementation, Case Study	10
	Total	**45**

Text Books:

1. Dale H.Besterfiled, Carol Besterfiled-Michna, *et.al.*, (2013), "Total Quality Management", *Pearson Education Asia*, 2004.
2. Mukherjee P. N. (2006), "Total Quality Management", *prentice Hall.*

Reference Books:

1. Bedi Kanishka (2013),"Quality Management", *Oxford University Press.*
2. Bagchi Tapan P (1993), "Taguchi Methods Explained Practical Steps to Robust Design", *prentice Hall, Classic.*
3. Lindsay Evans (2007), "An Introduction to Six Sigma & Process Improvement", *Thomson South-Western.*

Term Work:

1. Assignment given by the faculty based on above syllabus (Min. 3).
2. Quizzes (Min. 3).

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Program: B. Tech. Integrated (Mechanical)				**Semester:** X	
Course: Design of Mechanical Systems				**Code:** BTIME10002	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	2	0	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Knowledge of Engineering Mechanics (BTIME03007), Design of Machine Elements - I and II (BTIME07003, BTIME08003)

Objective:

- To provide the understanding of detailed design of mechanical systems and their uses in different application under different load conditions and safety limits.
- To impart knowledge of the fundamentals of design of some important mechanical systems.

Outcomes:

After completion of the course, students would be able to:

- Understand and design of pressure vessels, belt conveyor
- Analyze design of components of IC engine
- Demonstrate importance of optimization in design of mechanical parts

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Cylinders and pressure vessels:** Thin cylinders, thin spherical vessels. Thick cylinders and principal stresses, Lames's, Clavarino's and Birnie's equations. Cylinder with external pressure, auto frottage, compound cylinders. Gasket and gasketed joints, uniform pressure vessels, end closers, openings in pressure vessels	12
2	**I.C. Engine components:** Main parts of IC engine, design of piston, piston rings, piston pin, cylinder, cylinder head, connecting rod, crank shaft, end bearings and end caps, valve gear mechanism.	10
3	**Design of hoisting mechanism:** Design of snatch block assembly including rope selection, sheave, hook, bearing for hook, cross piece, axle for sheave and shackle plate. **Design of belt conveyors:** Power requirement, selection of belt, design of tension take up unit, idler pulley	13
5	**Optimum Design:** Objectives of optimum design, optimum design of mechanical elements using differential calculus and Lagrange multiplier method, concept of adequate design.	10

	Johnson's method: primary, subsidiary and limit equations, case of normal specifications, redundant and incompatible specifications.	
	Total	**45**

Text books:

1. J. E. Shigley and C. R. Mischke (2008), "Mechanical Engineering Design", *McGraw Hill Pub. Co. Ltd.*
2. V. B. Bhandari (2010), "Design of Machine Element", *McGraw Hill Education Pvt. Ltd, New Delhi.*
3. Rudenko (1981) (Classic), "Material Handling Equipment" *M.I.R. Publishers, Moscow.*

Reference Books:

1. N. C. Pandya and C. S. Shah (2006), "Machine Design" *Charotar Publishing house Pvt LTD, Anand.*
2. R. C. Johnson (1971) (Classic), "Mechanical Design Synthesis with Optimisation Applications", *Von-Nostrand-Reynolds Pub.*
3. V. M. Faires (2008), "Design of Machine Element", *McMillan.*
4. V.B.Bhandari (2013) "Machine Design Data Book" Mcgraw Hill Education (INDIA)

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Term Work:

1. The design and drawing of any one mechanical system such as pressure vessel, conveyor system or hoisting system.
2. Assignments based on above topics.(Minimum 3)
3. Viva - Voce examination

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Program: B. Tech. Integrated (Mechanical)				**Semester :** X	
Course : Engineering Economics, Costing and Accounting				**Code :** BTIME10003	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	0	3	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Basic Mathematics and Statistical Techniques (BTIME03004, BTIME04005)

Objectives:

- To impart the basic knowledge of economics, costing and accounting.
- To develop the ability of the decision on financial matter in industry by analyzing the economic and financial environmental of the industry.

Outcomes:

After completion of the course, students would be able to:

- Understand the basic concepts of economics and accounting.
- Understand the basics of demand utility analysis.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Managerial Economics:** Definition and Concept of economics, microeconomics and macroeconomics, Economic systems, Methodology of Economics, Nature of Managerial Economics, Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis	05
2	**Demand Utility Analysis:** Demand, Types of demand, Laws of Demand Determinants of demand, Demand function, Demand elasticity, Demand forecasting, Meaning of Utility, Marginal Utilities, basic laws of consumption Supply, Determinants of supply, Supply function, Supply elasticity.	09
3	**Financial Management:** Requirements and use of money, Short term and long term uses of money, Sources of funds, Financial institutions, Capital investments, Working capital, Entrepreneurial finance analysis, Time value of money, Evaluation of cash flows, Annuities, Investment risks and returns, Depreciation, Comparison of investments, Preparation of budgets and budgetary control, Projects and contracts planning.	09
4	**Accounting:** Basic accounting concepts and principles of accounting, Role of accountant Purpose and context of the accounting framework, Introduction to the financial statements from typical Annual Reports of the Organizations, Double entry	09

	bookkeeping, Books of prime entry, data processing using computer.	
5	**Production and cost analysis:** Production function - Returns to scale - Production optimization - Least cost input - Isoquants - Managerial uses of production function. **Cost Concepts: Cost function** - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.	09
6	**Introductions to costing:** Cost sheets; Process costing-simple numerical. Use and preparing statements. Applications for easy cost sheets and process accounts per unit cost, budgeting, forecasting, comparisons between 2 or more goods produced.	04
	Total	**45**

Text Books:

1. Mr. Maheshvari (2012), "Managerial Economics", *PHI.*
2. Dr. Jawahar Lal (2017), "Accounting for Management", 5th Edition, *Himalaya publication house.*
3. Mr. Babatosh Banerji (2006), "Costing", *PHI.*

Reference Books:

1. Paresh Shah (2007), "Basic Financial Accounting for Management", *Oxford University Press.*
2. Samuelson Paul A and W. D. Nordhaus (2001), "Economics", *TMH, New Delhi.*
3. McGuigan, Moyer and Harris (2007), "Managerial Economics, Applications, Strategy and Tactics", *Thomson South Western.*
4. Salvatore Dominick (2003), "Managerial Economics in a Global Economy", *Thomson South Western.*
5. Prasanna Chandra (2007), "Fundamentals of Financial Management", *TMH, New Delhi.*

Term work:

1. Assignments given by Faculty on above syllabus (Min. 3).
2. Viva Voce

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SVKM's Narsee Monjee Institute of Management Studies
Mukesh Patel School of Technology Management & Engineering

Program: B. Tech. Integrated (Mechanical)				**Semester:** X	
Course : Project Part - II				**Code:** BTIME10004	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (100 Marks)**	**Theory (------)**
0	8	0	4	Scaled 100 marks	-

Pre-requisite: All Mechanical Engineering subjects till semester VIII

Objectives:

- To train the student to develop and carry out research work independently.
- To develop the skills of preparation and presentation.

Outcomes :

After completion of the course, students would be able to:

- Demonstrate the use of knowledge of basic Mechanical Engineering subjects
- Develop the methodology of analysing the given topic based on the literature survey and experimental data.
- To handle assignments independently on their own
- Develop presentation and communication skill

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	Each student must have to submit draft copy of Project and he/she will make progress seminar presentations for 30 minutes in presence of External Examiner and respective Guide.	08
	Total	**08**

Internet References: As prescribed by Faculty

Detail guidelines for the project:

Project – Phase 2 Activities to be done:

1. The second phase of the project will involve Design and Part Implementation
2. Student is required to submit 1-2 pages weekly report on the work done to the Mentor. There would continuous evaluation based on the weekly report submitted.
3. Report primarily containing Design & Part Implementation (Code) is to be submitted at the end of the Semester. (Spiral Bound Report)
4. Presentation (About 30 Minutes) of the work done during the Semester to be evaluated by Internal Examiner and Project Mentor.

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Program: B. Tech. Integrated (Mechanical)				**Semester :** X	
Course: Elective II - Dynamic System Modeling and Analysis				**Code :** BTIME10005	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Engineering Mathematics - I, II and III (BTIME03004, BTIME04005 and BTIME05006), Engineering Thermodynamics (BTIME03002)

Objective:

- To understand physical systems e.g. mechanical, electrical, thermal and fluid systems and converting them to mathematical models.
- To understand the mathematical Modeling and response analysis of dynamic systems that is required in Mechanical engineering.
- To learn the use of any mathematical software.

Outcomes:

After completion of the course, students would be able to:

- Understand elastic, inertial and damping property of physical system.
- Apply Laplace transform to find out the gain of the system
- Solve the system and modify using any mathematical software like MATLAB, MATHEMATICA, to find the final optimize solution.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction to system dynamics:** Introduction, Mathematical Modeling of Dynamic System, Analysis and Design of Dynamic Systems.	05
2	**The laplace transform:** Introduction, Complex Numbers, Complex Variables, and Complex Functions, Laplace Transformation, Inverse Laplace Transformation, Solving Linear, Time-Invariant Differential Equations, Example Problems and Solutions, Problems.	05
3	**Mechanical systems:** Introduction, Mechanical Elements, Mathematical modeling of simple Mechanical systems, Work, Energy, and Power, Example Problems and Solutions, Problems.	06
4	**Transfer-Function approch to modeling dynamic system:** Introduction, Block Diagrams, Partial-Fraction Expansion with MATLAB, Transient-Response Analysis with MATLAB, Example Problems and Solutions, Problems.	08
5	**State-Spaceapproch to modeling dynamic system:** Introduction, Transient-Response Analysis OF Systems in State-Space Form with MATLAB, State-Space Modeling of System with Input Derivatives,	07

	Transformation of Mathematical Models with MATLAB, Example Problems and Solutions, Problems.	
6	**Electrical systems and electromechanical systems:** Introduction, Fundamentals of Electrical Circuits, Mathematical Modeling of Electrical Systems, Analogous Systems, Mathematical Modeling of Electromechanical Systems, Mathematical Modeling of Operational-Amplifier Systems	08
7	**Fluid systems and thermal systems:** Introduction, Mathematical Modeling of Liquid-Level Systems, Mathematical Modeling of Pneumatic Systems, Linearization of Nonlinear Systems, Mathematical Modeling of Hydraulic Systems, Mathematical Modeling of Thermal Systems	06
	Total	**45**

Text Books:

1. Oghata (2007), "System Dynamics" *Pearson Publications.*
2. Norman Nise (2008), "Control System Engineering" *Wiley.*

Reference Books:

1. Close, Fredrik (2001), "Modeling and Analysis of Dynamic System" *Wiley.*
2. Narsico, George Julius (2005), "Modelling and Control of Dynamic System" *Thomson.*

Term Work:

1. Five Assignments based on above topics (Min. 3).
2. Viva Voce Examination

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Program: B. Tech. Integrated (Mechanical)				**Semester:** X	
Course: Elective II - Reliability Engineering				**Code:** BTIME10006	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Prerequisite: Engineering Mathematics - I & II (BTIME03004 & BTIME04005)

Objective:

- To understand the concept of reliability and its significance in manufacturing of critical components / assemblies / systems.
- To familiarize with failure analysis techniques of reliability improvement, reliability testing and predictions.

Outcomes:

After completion of the course, students would be able to:

- Understand the Reliability terminology and its interrelationship with quality for evaluation of safety standard.
- Understand and write the derivations on mean life, median life and model life of different distributions.
- Conduct Product Reliability Acceptance tests, Stress screening, Degradation Tests, MTBF, CI, Hypothesis Testing, Goodness of Fit, Kolmogorov-Smirnov test, Anderson Darling Test.

Detailed syllabus: (per session plan)

Units	**Description**	**Duration**
1	Reliability program management, Benefits of reliability engineering, Interrelationship of quality and reliability, Failure consequence and liability management, Integrated reliability program, concurrent engineering System Safety and evaluation of its conformance to standards Safety labels, Reliability Terminology	05
2	Mathematical definition of reliability and unreliability, hazard function, cumulative hazard function, reliability function, mean life, median life, modal life	04
3	Typical Life-time distributions (Poisson, Exponential, Weibull, Gamma, Beta), derivations of mean life, variance, median life etc. for different distributions	04
4	Ranking of life data, probability plotting, Poisson process, non-repairable and repairable systems, bath-tub curve for repairable system	04
5	Reliability design techniques, Use factors, Stress-strength analysis Introduction to FMEA and FMECA from reliability perspective, Fault tree analysis (FTA) in design, Monte Carlo simulation	05

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6	Reliability of Mechanical components and systems, Fatigue, S-N Diagram, Miner's rule, Effects of Creep, Wear, Corrosion, Vibration and shock, Temperature	04
7	Reliability modeling and prediction, Reliability block diagrams and models, part count predictions and part stress analysis, reliability prediction methods for repairable and non-repairable devices, Reliability apportionment, reliability allocation	05
8	Development testing, elements of a reliability test plan, Accelerated life tests (e.g., single-stress, multiple-stress, sequential stress), Step-stress testing	04
9	Product testing, Qualification/Demonstration testing (Sequential tests, Fixed length tests), Product Reliability Acceptance tests, Stress screening, Degradation Tests, MTBF, CI, Hypothesis Testing, Goodness of Fit, Kolmogorov-Smirnov test, Anderson Darling Test	05
10	Maintainability and availability, Maintainability and availability planning, Maintainability apportionment/allocation, Availability tradeoffs, Maintenance time distributions, Preventive and Corrective maintenance (PM) analysis.	05
	Total	**45**

Text Books:

1. P. D. T. O. Connor (2012), "Practical Reliability Engineering", *John Wiley.*
2. "NY's RAC sheets on Reliability Engineering", (1998), *System Reliability Center, Rome.*

Reference Books:

1. R. A. Johnson (2007), "Probability and Statistics for Engineers", *PHI Publications.*
2. Juran (2010), "Quality Hand Book", *Tata McGraw Hill.*

Term Work:

1. Assignments based on the topics of the syllabus (Min. 3).
2. Seminar or presentation on topic based on syllabus.
3. Viva voce

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Program: B. Tech. Integrated (Mechanical)				**Semester:** X	
Course: Elective II - Computational Fluid Dynamics				**Code:** BTIME10007	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: Knowledge of Fluid Dynamics (BTIME05004), Heat Transfer (BTIME07001)

Objectives:

- To provide the understanding of basics of CFD and application perspective.
- To impart the knowledge of governing differential equations, grid generation and discretization methods.
- To provide the understanding of solution methods of finite difference equations.
- To introduce techniques to solve problems related to heat transfer and fluid flow.

Outcomes:

After completion of the course, students would be able to:

- Understand the basics of CFD and working of CFD software and their solution methodology.
- Set up governing differential equations, boundary conditions and initial conditions.
- Understand the basics of finite difference, finite element and finite volume methods.
- Derive the discretized equations and do finite difference formulation and control volume formulation.
- Analyze the problems related to heat transfer, fluid flow, convection and diffusion and solve them.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction to CFD:** scope and application of CFD, methods of predictions like experimental, theoretical working of commercial CFD softwares, solution methodology-preprocessing, solver, post processing.	03
2	**Mathematical description of Fluid Flow:** Governing Differential Equations, Meaning of Differential equation, The Continuity Equation, A Momentum equation, The Energy Equation The General Differential Equation, Boundary Conditions, Initial and Boundary Conditions, Initial and Boundary Value problems.	08

	One-dimensional computations by Finite Difference, Finite Element and Finite Volume methods.	
3	**Grid Generation and Discretization Methods:** Structured and unstructured Grids, O-type, H-type, C-type of Structured Grid Generation, Mesh Adaptation, The Nature of Numerical Methods, The Discretization Concept, The Structure of the Discretization Equation, Methods of Deriving the Discretization Equations, Taylor-Series Formulation, Variational Formulation, Method of Weighted Residuals, Control Volume Formulation.	08
4	**Solution Methods of Finite Difference Equations:** Elliptic equations – Finite difference formulations, Iterative Solution Methods, Direct method with Gausian Elimination; Parabolic Equations – Explicit Schemes and Von Neumann Stability Analysis, Implicit Schemes.	08
5	**Application of CFD to Heat Flow:** Steady One-dimensional Flow, Unsteady One-dimensional Flow Two and Three-dimensional Situations, Over relaxation and Under relaxation	06
6	**Application of CFD to Convection and Diffusion:** Steady One-dimensional and Two Dimensional Convection-Diffusion, Unsteady One-dimensional Convection-Diffusion, Unsteady Two-dimensional Convection-Diffusion.	06
7	**Application of CFD to Incompressible Fluid Flow:** Governing Equations, Stream Function-Vorticity Method, Determination of Pressure for Viscous Flow, The SIMPLE, SIMPLER Algorithm, Introduction to Turbulence Modeling, Basic Theories of Turbulence.	06
	Total	**45**

Text books:

1. H. K. Versteeg, W. Malalasekera (2007), "An Introduction to Computational Fluid Dynamics- The Finite Volume Method", 2nd Edition, *Prentice Hall.*
2. J. D. Anderson (2012), "Computational Fluid Dynamics-The Basics with Applications", *McGraw Hill.*

Reference Books:

1. P. Niyogi, M.K. Laha, S. K. Chakrabarty (2013), "Introduction to Computational Fluid Dynamics", *Pearson Education, India.*
2. Suhas V. Patankar (2013), "Numerical Heat Transfer Fluid Flow", *Hemisphere Publishing Corporation.*
3. T.J. Chung (2010), "Computational Fluid Dynamics", *Cambridge University Press.*

Term Work:

1. Assignments given by the faculty based on above syllabus (Min. 3).
2. Assignments using any commercial CFD software.
3. Viva voce

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Program: B. Tech. Integrated (Mechanical)				Semester: X	
Course: Elective II – Robotics				Code: BTIME10008	
Teaching Scheme				Evaluation Scheme	
Lecture Hours per week	Practical Hours per week	Tutorials Hours per week	Credit	Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)	Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Pre-requisite: CAD/CAM/ CIM (BTIME07002), Engineering Mathematics - I and II (BTIME03004 and BTIME04005)

Objective:

- To provide the understanding of basics of robotics and their elements
- To give the basics of robot kinematics and dynamics
- To provide the basics of robot programming with specific category of applications.

Outcomes:

After completion of the course, students would be able to:

- Know the kinematics and dynamics of Robot arm, sensor and intelligent devices for robot drives, power transmission systems and control.
- Write the basics of robot programming with specific category of applications.
- Know the physical configuration and mathematical description of different types of a real life robotic arm which describes a robot in industrial scenario.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Introduction:** History, present status and future trends, robotics and automation, laws of robotics, robot definition, robotics systems and robot anatomy, specifications of robots, resolutions, repeatability and accuracy of a manipulator.	05
2	**Robot Arm Kinematics:** A brief overview of transformations and kinematics of robots. The direct kinematic problem, the inverse kinematic solution, problems.	10
3	**Robot Arm Dynamics:** Introduction, Lagrange-Euler formulation, Newton-Euler formulation, generalized D'Alembert equations of motion, problems.	10
4	**Drives, Transmission and End Effectors:** Robot drives, power transmission systems and control, robot drive mechanisms, hydraulic, electric, pneumatic drives, mechanical transmission method, rotary-to-rotary motion conversion, rotary-to-linear motion conversion, end effectors, types, gripping problem, remote centered compliance devices, control of actuators in robotic mechanisms.	10
5	**Sensors and intelligent Robots:** Sensory devices, non-optical position sensors, optical position sensors, velocity sensors, proximity	05

	sensors, contact and non-contact type, touch and slip sensors, force and torque sensors, AI and robotics.	
6	**Application of Robots:** Capabilities of robots, robotic applications, obstacle avoidance, robotics in India, the future of robotics.	05
	Total	**45**

Text Books:

1. M. Gopal (2002), "Robotics", *PHI.*
2. K. S. Fu, R. C. Gomaler and C. S. G. Lee (2008), "Robotics: Control Sensing, Vision, Intelligence", *Tata McGraw Hill.*
3. M. P. Groover (2008), "Industrial Robotics", *Tata McGraw Hill.*

Reference Books:

1. Shuman, Y. Nof (1999), "Handbook of Industrial Robotic", *John Wiley and Sons.*
2. Deb. S. R. (2008), "Robotics Technology and Flexible Automation", *Tata McGraw Hill.*

Term Work:

1. Assignments based on the syllabus (Min 3).
2. Viva Voce.

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Program: B. Tech. Integrated (Mechanical)				**Semester :** X	
Course: Elective II - Operations Research				**Code:** BTIME10009	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorials Hours per week**	**Credit**	**Internal Continuous Assessment (ICA)As per Institute Norms (50 marks)**	**Term End Examinations (TEE) Theory (3 Hrs, 70 Marks)**
3	0	2	4	Scaled to 30 marks	Scaled to 70 marks

Prerequisite: Nil

Objective:

- Ability to understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively
- Knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry and real- life by using linear programming, assignment and transportation modeling, game theory, queuing model and simulation model.

Outcomes :

After completion of the course, students would be able to:

- Recognize the importance and value of Operations Research and mathematical modeling.
- Analyze and apply a managerial decision problem into a mathematical model in industry.
- Apply linear programming, assignment and transportation modeling, game theory, queuing model and simulation model to solve the real-life problems in industry.

Detailed Syllabus: (per session plan)

Units	Description	Duration
1	**Linear Programming Models:** Introduction to, its historical development, introduction to mathematical programming models and computational techniques, linear programming and simplex method, sensitivity analysis, manual solution of problems involving upto three iterations.	10
2	**Assignment, Transportation and Network Models:** Minimizations, maximization model, conditional assignment. Formulation-Flight scheduling problem, transportation model: minimization, maximization model, unbounded problems, Northwest corner rule	10

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	allocation, Vogels approximation, Optimisation, Modi method (u-v method), Degeneracy.	
3	**Game theory or Competitive strategies:** Limited to two person zero sum games; domination, saddle point, pure and mixed strategies, graphical and analytical methods; LP model formulation.	08
4	**Queuing /Waiting line Models:** Steady state analysis for M/M/1, hazard rate and system performance criteria; Erlangian distribution in series; waiting period in M/M/1 system with finite population (no derivation for these for cases), Replacement Model.	09
5	**Simulation Models:** Monte Carlo or experimenting method based on probabilistic behavior data and random numbers, application in probabilistic real life problems.	08
	Total	**45**

Text Books:

1. H. A. Taha (2004), "Operations Research - An Introduction", 6th Edition, *Prentice Hall of India Private Limited, N. Delhi.*
2. F. S. Hillier (1994), "Operations Research", 1st Indian Edition, *CBS Publishers and Distributors, Delhi.*

References Books:

1. H. M. Wagner (2009), "Principles of Operations Research with Application to Managerial Decisions", 2nd Edition, *PHI Learning.*

Term work:

1. Assignments based on syllabus (Min. 3).
2. Viva voce
3. Case Studies/Presentations/Project

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Signature
(Prepared by Concerned Faculty/HOD)

Signature
(Approved by Dean)

SVKM's Narsee Monjee Institute of Management Studies
Mukesh Patel School of Technology Management & Engineering

Program: B.Tech. Integrated (Mechanical Engineering)				**Semester :** XI	
Course/ Module : In-plant Training Phase I				**Module Code:** BTIME11001	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 300)**	**Term End Examinations (TEE) (Marks- ---)**
0	40	0	15	Marks Scaled to 300	---

Pre-requisite: Domain Knowledge of relevant stream

Objectives:

To provide the students with adequate industry exposure so as to: (prepare them, inculcate…

1. Understand various industrial aspects
2. Identify, analyze and solve engineering problems from relevant industry.

Outcomes:

After completion of the course, student would be able to:

1. Understand industrial practices and work culture to integrate theory with practice with the help of industrial practitioners.
2. Enhance communication skills and maintain discipline, safety norms and environmental awareness.
3. Interpret and solve industrial.
4. Develop ability to participate in teams.

Guidelines:

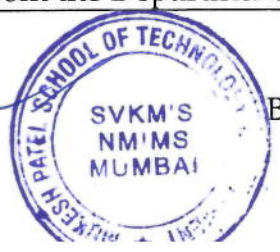
Inplant Training, Trainee's Code of Conduct:

Trainee is required to:

- Join on the stated date and complete the training as specified by the Industry
- Fill the Joining Report, get it endorsed by the concerned Industry Official and email the scanned copy within One week of joining to the Placement Department and Faculty Mentor.
- Adhere to all the rules and regulations, safety norms of the Industry and thereby ensure professional conduct
- Take instructions from the Industry Mentor on a daily basis and complete the same with due diligence and quality
- Fill the Weekly log book, get it endorsed by the concerned Industry Official and then email the scanned copy within a week to the Faculty Mentor

Mentoring process:

- Every in plant trainee shall be allocated two Mentors: an Industry Mentor and a Faculty from the Department (appointed by Head of the Department).



- Faculty Mentor shall connect with the Industry Mentor and the Trainee on a periodic basis.

Training Report:

- Students should take guidance from faculty and industry mentor and prepare a report on their work done in Inplant training and one copy should be submitted to the Institute.
- The report should be prepared in a format prescribed by the University.

Interim Presentation
It should give overview about the training to be done.

Report : Interim Report (IR)
(One copy to be submitted each to Internal mentor & Company Mentor)
This report must cover the following aspects:

a. *Synopsis*: A statement of about 100-words describing what the training is about.
b. *Goals*: Stating what the training will accomplish
c. Schedule: A time frame indicating steps that will be required and the expected date when they will be completed.
d. *Reference*: Bibliography and internet materials referred.

Final Presentation
The Final Presentation will evaluate the students in terms of the following

a. Knowledge of basic concepts
b. Ability to identify and analyze the problem
c. Ability to apply the knowledge to solve the problem
d. Logical development of the subject
e. Effective oral communication

Training Report
(One copy to be submitted each to Institute& Company Mentor)
The Report (Interim Report and Final Report), which is the written component of evaluation, is judged for the following points.

1. Comprehensive study of the problem & objective
2. Methodology and implementation
3. Ability to analyze the problem
4. Logical sequencing, organizing and data handling
5. Findings, observations, concluding remarks in terms of the objectives set earlier and the future scope of the problem.

The Training Report is to be prepared based on the guidelines given by Institute.

In-plant Training Evaluation Scheme

Evaluation Phases	Evaluation	Marks	Duration	Remarks
Weekly Log book	Weekly progress report	100	15 Weeks	Evaluated by Industry Mentor
Interim	Weekly log book (30 Marks Internal Mentor), Interim Presentation and Report (70 Marks)	100	Between 8th to 10th week	Panel of at least two faculty mentors / members
Final	Final Presentation and Report	100	End of the term	Panel: Industry and Internal
Total Marks		300		

Details of Internal Continuous Assessment (ICA)

Test Marks: --
Term Work Marks: 300

Signature
(Prepared by Concerned Faculty/HOD)

Signature
(Approved by Dean)

SVKM's Narsee Monjee Institute of Management Studies
Mukesh Patel School of Technology Management & Engineering

Program: B.Tech. Integrated (Mechanical Engineering)				**Semester:** XII	
Course/ Module : In-plant Training Phase II				**Module Code:** BTIME12001	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 300)**	**Term End Examinations (TEE) (Marks- ---)**
0	40	0	15	Marks Scaled to 300	---

Pre-requisite: Domain Knowledge of relevant stream

Objectives:

1. To make the student conversant with industrial activities, organizational behavior and ethics.
2. To understand various industrial aspects viz. manufacturing processes, industrial design, productivity improvement, value engineering, quality control.
3. To identify, analyze and solve engineering problems from relevant industry.

Outcomes:

After completion of the course, student would be able to:

1. Understand industrial practices and work culture to integrate theory with practice with the help of industrial practitioner.
2. Enhance communication skills and maintain discipline, safety norms and environmental awareness.
3. Interpret and solve routine technical problems through the application of engineering principles.
4. Understand leadership and managerial skills.

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