SVKM's Narsee Monjee Institute of Management Studies

Mukesh Patel School of Technology Management & Engineering

Program: B. Tech (Mechanical Engineering)				**Semester:** V	
Course: Thermal Engineering				**Code:** BTME05001	
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 and II (BTAB01001, BTME02001), Engineering Thermodynamics (BTME03002)

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, steam turbines and analyzing their performance.
- Apply fundamentals of compressible fluid flow to analyze gas and steam nozzles.
- Understand gas power cycles, vapour power cycles and analyze their performance.

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
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.	10

	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.	
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 (Mechanical Engineering)				**Semester:** V	
Course: Manufacturing Processes - II				**Code:** BTME05002	
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: Manufacturing Processes - I (BTME03106)

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:

- Understand the metal cutting process with tool geometry and forces of cutting.
- Select appropriate type of manufacturing process, materials for given design.
- Compare different non-conventional process according to industrial application.

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
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	06

	discharge machining (EDM), Electro-chemical machining (ECM), Electro-chemical grinding (ECG), applications of different Nonconventional machining processes, Laser Beam machining and allied process.	
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.*

Term Work:

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 (Mechanical Engineering)				**Semester:** V	
Course: Design of Machine Elements - I				**Code:** BTME05003	
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: Material Engineering (BTME04004), Engineering Mechanics (BTAB01005, BTME02004) and Strength of Material (BTME03003).

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, springs, fasteners and power screws under static load condition based on strength and stiffness criteria.

Outcomes:

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

- Understand the importance materials in design and select appropriate materials for safe design.
- Apply 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, springs, fasteners and power screws under static loads.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Fundamentals of design**: Basic procedure, sources of design data, use of standards, synthesis and creativity, material selection, factor of safety, service factor, stress concentration, theories of failure, maximum normal stress theory, maximum shear stress, maximum distortion energy theory.	08
2	**Design of simple machine parts:** Cotter joint, knuckle joint, levers, and turn buckle.	04
3	**Design of shafts:** ASME code, design of shaft on strength and torsional rigidity basis, design of transmission shaft. **Design of keys**: Saddle, sunk, feather, and woodruff. **Design of coupling**: Muff, flange, flexible and bush pin coupling.	10
4	**Design of fasteners:** Bolted joints, riveted joints, and welded joints and design for transverse and eccentric loading.	06
5	**Power screws:** Forms of thread, multiple threads, torque analysis with square and trapezoidal threads, self-locking, collar friction torque, stresses in power screw, screw jack.	08

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6	**Spring design**: Types applications and material for springs, stress and deflection equation of helical spring, design of helical compression, spring in series and parallel, leaf spring design.	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. (Mechanical Engineering)				**Semester :** V	
Course : Mechatronics and Controls				**Code :** BTME05004	
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 (BTME03004), Industrial Electronics (BTME04007)

Objectives:

- To understand the principles of a multi-disciplinary approach in the development of efficient and productive Mechatronics systems.
- To study hydraulic, pneumatic and PLC systems employed in modern manufacturing industry.
- To introduce the concepts of Control Engineering.

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 indigenous mechatronics system.
- Understanding basic hydraulic and pneumatic circuits and simple ladder logic diagram to be used in modern manufacturing industries.
- Analyze system/process for standard input responses.

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.	02
2	**Sensors & Actuators:** 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, Linear motion drives. Electrical actuators - DC Motors, Stepper Motors, Servo motors, Induction Motors, Hydraulic and Pneumatic actuation. Selection of actuators.	08
3	**Hydraulic & Pneumatic System:** Fundamentals of hydraulics, Pascal's law, ISO symbols, Accumulators, Design of typical hydraulic circuits - regenerative circuit, Meter in and meter out circuit, sequence circuit, Bleed-off circuits, Counter balancing circuits, Construction and working of Air Compressor and FRL Unit, Development of single and multiple actuator circuits, Sequencing circuits using Electropneumatics / Electrohydraulic.	12

4	**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.	**04**
5	**Introduction to Control System:** Classification of control system, Effect of feedback. Mathematical modelling of control systems, Introduction to transfer function. Block diagram algebra, and Signal flow graphs and Mason's Gain formula	**05**
6	**Time response analysis:** Time response of control system, Standard test signal, Time Domain specifications, analysis of different type of systems using step. Ramp and parabolic inputs. Response with P, PI, PD, PID Controller.	**05**
7	**Stability analysis and Root Locus Technique:** Introduction to concepts of stability. The Routh and Hurwitz stability criteria. Relative stability analysis. Frequency Response Analysis, Polar Plots. Bode Plots, Nyquist Plots,	**09**
	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.*
3. Nagraath Gopal (2010) Control Systems Engineering -Principles and Design, *New Age Publishers*

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.*
4. K. Ogata (2001), "Modern Control Engineering", 3rd Edition. *Prentice Hall of India*

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.
10. Study and Verification of P, I, D, P+I, P+D, P+I+D control actions.
11. Modelling of simple mechanical system using MATLAB.
12. Plotting Root locus and Bode plot using MATLAB.

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Program: B. Tech. (Mechanical Engineering)				**Semester :** V	
Course : Mechanical Measurement and Metrology				**Code :** BTME05005	
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 Physics (BTAB01002)

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

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
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	06

	Wheatstone's network using strain gauges, mounting of strain gauges.	
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. R. K. Jain (2009), "Engineering Metrology", *Khanna Publishers.*
3. T. G. Buckwith and N. L. Beck (1991), "Mechanical Measurements", *Addison Wesley*

Reference Books:

1. K. Sawhney (2002), "Electrical and Electronic Measurements and Instrumentation", *Dhanpat Rai and Sons.*
2. E.O. *Doebelin* and *D. N. Manik* (2010), "*Doebelin's* Measurement Systems", 6th Edition, *Mc Graw Hill.*

Term Work:

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

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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 (Mechanical Engineering)				**Semester:** V	
Course: Machine Shop – II				**Code:** BTME05006	
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 (-----)**
0	2	0	1	Scaled to 50 marks	-

Pre-requisite: Workshop Practice (BTME02007), Machine Shop - I (BTME03007)

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 requirements for assembling jobs with different types of operations.
- Operate different types of machines such as milling, shaping and grinding.
- Practise different machining operations to create an assembly of jobs.

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 (Mechanical Engineering)				**Semester:** V	
Course: Industrial Engineering				**Code:** BTME05007	
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 (BTME03106)

Objectives:

- To introduce various approaches to productivity.
- To impart knowledge of work-study techniques for examination of human work.
- To apply ergonomic principles 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 productivity of resources for improvements.
- Improve 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. Interdependence between working conditions and productivity. Significance of theory of Scientific Management. Improving Efficiency and Productivity through Work study. Work study components. Relationship between Method Study and Time Study.	06
2	**Method Study:** Basic procedure of method study. Factors in selecting a job to a studied. Recording the facts with charts and diagrams. Questioning technique for development of new method. Role of Management and workers in implementation.	08
3	**Facilities & Workplace Design:** Aligning the physical facilities- plant layout, equipment and work flow as per the production processes. Prinicples of Motion Economy. Standardisation of the process.	05
4	**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. Predetermined time standards. Use standard data. MOST for work measurement. Use of time standards.	10

5	**Ergonomics:** Field of Ergonomics. Physical and cognitive issues of ergonomics. Aims of ergonomics considerations. Working postures of operatives. Design of objects, facilities and environment. Anthropometrical details. Database of human factors. Ergonomic improvement of physical and cognitive issues. Ergonomics principals. Information input and human control of systems. Work space and arrangement. Living environment. Visual displays	07
6	**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. *International Labour Office* (2014), "Introduction to Work Study", OXFORD & IBH Publishing Co. Ltd.
2. Ralph Barnes (2002), "Time & Motion study", *Asia Publishing*.

Reference Books:

1. M. S. Sanders & E J McCormick (2002), "Human factors in Engineering & Design", *Tata McGraw Hill*.
2. K. B. Zandin (2003), "Most Work Measurement System".
3. Merton E. Davis, William D. Falcon, Value Analysis (2002), "Value Engineering: The Implications for Managers", *American Management Association*.
4. Otto, K. N. (2008), "Product Design", *Pearson Education*.

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 work study 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. Atleast one Case Study for Value Engineering

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Program: B.Tech. (Mechanical Engineering)				**Semester :** V	
Course : Numerical Methods				**Code :** BTME05008	
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: Fundamental Knowledge of Calculus and Algebra.

Objectives:

1. To provide knowledge of numerical approximation theory in the process of solving mathematical problem.
2. Inculcate the idea of convergence analysis of numerical methods associated with numerical computation.

Course Outcomes:

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

1. Solve algebraic, transcendental and differential equations using numerical methods.
2. Implement appropriate techniques of numerical differentiation and integration in solving relevant problems.
3. Apply interpolation and curve fitting techniques to discrete numerical data.
4. Estimate and analyse errors in the numerical solution of mathematical problems.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1.	**Errors in Numerical Computation:** Types of Errors, Analysis & Estimation of Errors, General Error Formula, Errors in Taylor's Series for Approximation of Functions.	5
2.	**Roots of Equations:** Bisection method, False position method, Newton-Raphson method, Secant method, Applications.	6
3.	**Systems of Linear Algebraic equations:** Graphical Method, Cramer's Rule, Matrix Inversion Method, Substitution Methods, Gauss-Elimination method, Gauss-Jordan method, Gauss- Jacobi Method, Gauss-Seidel method, Pitfalls & improvement in each case, power method for eigenvalues, Jacobi's method to find the eigenvalues of a symmetric matrix.	10
4.	**Interpolation:** Forward, Backward and Central Differences, differences of a polynomial, Newton's Interpolation formulae, Stirling's Central Difference interpolation formula, Lagrange's formula for unequal intervals.	6
5.	**Curve fitting:** Least square method for straight line and parabola, Method of group averages.	3

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6.	**Numerical differentiation:** Derivative using Newton's forward difference and backward difference interpolating formula, Maxima Minima of Tabulated Function.	6
7.	**Numerical Integration:** The Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule.	3
8.	**Solution to Ordinary differential equations:** Taylor series method, Euler's method, Modified Euler's method, Runge-Kutta method, Picard's method of successive approximation.	6
	Total	45

Text Books:

1. S. S. Sastry, Introduction to methods of numerical analysis, PHI, 5th Edition, 2013.
2. Saumyen Guha, Rajesh Srivatsava, Numerical Methods for Engineering and Science, Oxford Higher education, 1st edition, 2010.

Reference Books:

1. Seven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill, 7th Edition , 2015.
2. S. R. K. Iyengar, R. K. Jain, Numerical Methods, New age international (p) limited, publishers, 5th edition, 2009.
3. E. Balagurusamy, Numerical Methods, McGraw-Hill, 1st edition, 2017.

Term Work: As per institution norms.

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