

STUDY & EVALUATION SCHEME

B. TECH. MECHANICAL ENGINEERING

3rd year

5th Semester

Sl. No.	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total
						Sessional			End Sem. Exam.	
			L	T	P	CT	TA	Total		
Theory Subjects										
1	IHU-501	Industrial Economics & Principles of Management	03	01	-	30	20	50	100	150
2	IME-502	Machine Design - I	03	01	-	30	20	50	100	150
3	IME-503	Dynamics of Machines	03	01	-	30	20	50	100	150
4	IME-504	Manufacturing Science - II	03	01	-	30	20	50	100	150
5	IME-505	Heat & Mass Transfer	03	01	-	30	20	50	100	150
6	IEME-02-	Elective-2	02	01	-	15	10	25	75	100
Practicals/ Training/ Project										
7	IME-552	Machine Design - I Lab	-	-	03	10	10	20	30	50
8	IME-553	Dynamics of Machines Lab	-	-	03	10	10	20	30	50
9	IME-554	Manufacturing Science - II Lab	-	-	03	10	10	20	30	50
10	IME-555	Heat & Mass Transfer Lab	-	-	03	10	10	20	30	50
11	GP-501	General Proficiency	-	-	-	-	-	50	-	50
TOTAL										1100

L – Lecture

T – Tutorial

P – Practical

CT – Class Test

TA – Teacher Assessment

Sessional Total = Class Test + Teacher Assessment

Subject Total = Sessional Total + End Semester Examination

LIST OF ELECTIVE SUBJECTS
B.TECH. MECHANICAL ENGINEERING

Elective –2 (Fifth Semester)

IEME-021	Reliability Engineering
IEME-022	Maintenance Engineering and Management
IEME-023	Industrial Engineering
IEME-024	Mechatronics

INDUSTRIAL ECONOMICS AND PRINCIPLES OF MANAGEMENT

IHU-501

w.e.f. Session 2014-15

L	T	P
3	1	0

UNIT –I

Introduction :

Nature and significance of Economics. Meaning of Science, Engineering and Technology and their relationship with economic development. **6**

UNIT-II

Basic Concepts:

The concept of demand and supply. Elasticity of Demand and Supply. Indifference Curve Analysis, price Effect, Income Effect and Substitution Effect. **6**

UNIT-III

Money and Banking :

Functions of Money, Value of Money, Inflation and measures to control it. Brief idea of functions of banking system, viz, commercial and central banking, Business fluctuations. **8**

UNIT-IV

Introduction:

Definition, Nature and Significance of Management, Evolution of Management thought, Interpersonal relationship and group behaviour. **10**

UNIT-V

Human Behaviour:

Factors of Individual behaviour, perception, learning and personality development, interpersonal relationship and group behaviour. **10**

Books:

1. Modern Economic Theory : Dewett K.K., Chand and Co.
2. Organizational Behaviour: Lathers Fred
3. Principles of Management: Prasad L.M.
4. A Text Book of Economic Theory: A.W. Stonier and D.C. Horgue, Oxford

MACHINE DESIGN-I

IME-502

w.e.f. Session 2014-15

L	T	P
3	1	0

UNIT –I

Introduction :

Definition, Methods, Standards in design and selection of preferred size.

4

Selection of Materials:

Materials for static and fatigue loads, Materials for components subjected to creep, BIS system of designation of steels, steels, plastics and rubbers. AISI (American Iron and Steel Institute) and ASTM rubber testing methods.

4

UNIT-II

Design against Static Load:

Modes of failure, Factor of safety, Stress-strain relationship, Principal stresses, Theories of failure.

4

Design against Fluctuating Load:

Stress concentration, Stress concentration factors, Fluctuating, alternating stresses, Fatigue failure, Endurance limit, Design for finite and infinite life, Soderberg and Goodman criteria.

4

UNIT-III

Joints :

Welded joints, Screwed joints, Riveted joints Eccentric loading of above joints, Design for fatigue loading.

4

Shafts, Keys and Couplings:

Design against static and fatigue loads, Strength and rigidity in design, Selection of square and flat keys and splines, Rigid and flexible couplings.

4

UNIT-IV

Mechanical Springs:

Design of Helical and leaf springs against static and fatigue loading.

4

Design Analysis of Power Screws:

Form of threads, Square threads, Trapezoidal threads, Stresses in screw, Design of screw jack.

4

UNIT-V

Introduction to Product Development and Design Process:

Definition of Design, Design Process, Need Analysis, Need based developments, Design by Evolution, Technology based developments, Examples, Case Studies and Brain-storming.

8

Books:

1. Design of Machine Elements: Bhandari, TMH.
2. Machine Design: Sharma and Agarwal, Kataria.
3. Machine Design: Maleev and Hartman, CBS
4. Machine Design: SI Edition by Shigley, McGraw Hill.
5. Machine Design: Black and Adams, McGraw Hill.
6. Design of Machine Elements: Spotts, PHI

DYNAMICS OF MACHINES

IME-503

w.e.f. Session 2014-15

L T P
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UNIT –I

Force Analysis, Turning Moment and Fly Wheel :

Static force analysis of linkages, Equivalent offset inertia force, Dynamic analysis of slider crank and 4 Bar mechanisms. Piston and Crank effort, Inertia, Torque, Turning moment diagrams, Fluctuation of energy, Flywheel.

7

UNIT-II

Balancing of Machines :

Static and dynamic balancing of rotating and reciprocating masses, Primary and secondary forces and couples.

5

UNIT-III

Friction :

Pivot and collar friction, Friction circle, Single plate, Multiplate and Cone clutches, Michelle and Kingsbury thrust bearing and rolling contact bearing, Belts and pulleys, Flat and V-belts, design and selection.

7

Brakes and Dynamometers (Mechanical Type):

External and internal shoe brakes, Band and Block brakes, Hydraulic brakes, Absorption and Transmission dynamometers.

7

UNIT-IV

Governors :

Dead weight and spring loaded governors, Sensitivity, Stability Hunting, Isochronism, Effort and Power, Friction and Insensitivity, Introduction to inertia Governors.

6

UNIT-V

Gyroscopic Motion :

Principles, Gyroscopic acceleration, Gyroscopic couple and reaction. Effect of gyroscopic couple upon the stability of aeroplanes, ships, two and four wheelers.

4

Mechanical Vibrations:

Single degree, free and forced vibrations, Undamped and Damped vibrations, Critical speeds.

4

Books:

1. Theory of Machines: Thomas Bevan, ELBS/CBS
2. Theory of Machines: S.S. Ratan, TMH
3. Theory of Machines: R.K. Bansal, Laxmi Publication
4. Mechanisms and Machines Theory: A.K. Ambekar, Jain Bros.
5. Theory of Machines: W.T. Green
6. Mechanisms and machines Theory: Rao and Duckipati, New Age
7. Theory of Machines and Mechanism; Ghosh and Mallik, EWP
8. Theory of Machines: P.L. Ballaney, Khanna

MANUFACTURING SCIENCE-II

IME-504

w.e.f. Session 2014-15

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UNIT –I

(A) Metal Cutting and Machine Tools:

Metal Cutting: Mechanics of metal cutting. Geometry of tools and nomenclature in ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required in cutting. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Brief introduction to machine tool vibrations and surface finish. Economics of metal cutting. **8**

UNIT-II

Machine Tools :

Lathe: Principle, types, operations, Turret/capstan, semi/Automatic lathes, Tool layout. **2**

Shaper, slotter, planer: operations and drives. **2**

Milling: Milling cutters, up and down milling, Dividing head and indexing, Maximum chip thickness and power required in milling. **2**

Drilling and boring: Drilling, boring and reaming tools. Geometry of twist drills. **2**

UNIT-III

Grinding and Super Finishing :

Grinding : Grinding wheels, abrasive, cutting action. Grinding wheel specification. Grinding Wheel- attritious wear, fracture wear. Dressing and truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centerless grinding. **4**

Super Finishing: Honing, lapping, polishing. **1**

Limits, Fits, Tolerances and Surface-Roughness:

Introduction to Limits, Fits and Tolerances IS standards, and Surface roughness. **3**

UNIT-IV

(B) Metal Joining (Welding):

Survey of welding and allied processes. Gas welding and cutting processes and equipment. Arc welding: Power sources and consumables. TIG and MIG welding processes and their parameters. Resistance welding-spot, seam and projection. Other welding processes such as atomic hydrogen, submerged arc, electro slag and friction welding. Soldering and Brazing. **4**

Thermodynamic and Metallurgical aspects in welding, Shrinkage and residual stresses in welds. Distortion in welds, defects in welds, their causes and remedies. **4**

UNIT-V

(C) Introduction to Non Conventional Machining and Welding:

Benefits, applications and working principle of EDM, ECM, LBM, EBM, USM, AJM, WJM, Similarly, nonconventional welding processes such as LBW, USW, EBW, Plasma arc welding and Explosive welding. **8**

Books:

1. Manufacturing Science: Ghosh and Mullick, EWP
2. Fundamentals of Metal Cutting and Machine tools: Boothroyd, McGraw Hill
3. Production Technology: R.K. Jain, Khanna
4. Production Technology H.M.T.
5. Production Engineering Sciences: P.C. Pandey and C.K. Singh, Standard Publishers
6. Modern Machining processes: P.C. Pandey and H.S. Shan, TMH
7. Materials and Process in Manufacturing: De Garmo, Prentice Hall
8. Fundamentals of Metal Cutting and Machine Tools: Juneja and Sekhon, New Age
9. process and Materials of Manufacturing : Lindburg, Prentice Hall
10. Advanced Machining Process: V.K. Jain, Allied Publishers.

HEAT AND MASS TRANSFER

IME-505

w.e.f. Session 2014-15

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UNIT –I

Introduction to Heat Transfer:

Concepts of the mechanisms of heat flow; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. 2

Conduction :

One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions. 3

Steady State One-Dimensional Heat Conduction :

Composite System in rectangular, cylindrical and spherical coordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation. 3

UNIT –II

Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. 4

Transient Conduction :

Transient heat conduction Lumped capacitance method, Time constant, unsteady state heat conduction in one dimension only, Heisler charts. 4

UNIT-III

Forced Convection:

Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer, Empirical heat transfer relations: Flow over a flat plate, Flow across a single cylinder and a sphere, Flow inside ducts; Relation between fluid friction and heat transfer; Liquid metal heat transfer. 4

Natural Convection:

Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical plates and cylinders, horizontal plates, cylinders, and spheres. 4

UNIT-IV

Thermal Radiation :

Basic radiation concepts; Radiation properties of surfaces; Black body radiation laws; Shape factor; Black-body radiation exchange; Radiation exchange between different non black bodies in an enclosure; Radiation shields; Solar radiation. 8

UNIT-V

Heat Exchanger :

Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness- NTU method; Compact heat exchangers. 3

Condensation and Boiling:

Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on a horizontal tube; Boiling modes, pool boiling curve, forced convective boiling. 3

Introduction to Mass Transfer:

Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion through a stagnant gas film. 2

Books:

1. Elements of Heat Transfer: Bayazitoglu and Ozisik, McGraw Hill
2. Heat Transfer: J.P. Holman, McGraw Hill
3. Schaum's Outline of Heat Transfer: Pitts and Sisson, McGraw Hill
4. Principles of Heat Transfer: Frank Kreith, McGraw Hill
5. Fundamentals of Momentum, Heat and Mass Transfer: James R. Welty, John Wiley
6. Heat Transfer: Vijay Gupta, New Age
7. Heat Transfer: V.C. Rao, University Press.
8. Heat Transfer; R. Yadav, Central Publishing House, Allahabad.

MACHINE DESIGN –I LAB

IME-552

(Say minimum 8 experiments out of the following)

w.e.f. Session 2014-15

L	T	P
0	0	3

1. Design and drawing of Riveted Joints for given operating conditions.
2. Design of an eccentrically loaded welded, riveted or bolted joint.
3. Design of bolted joint for fluctuating loads.
4. Design and drawing of a cotter joint.
5. Design and drawing of a knuckle joint.
6. Design and drawing of a simple screw jack.
7. Design of shaft for different loading conditions.
8. Design and drawing of rigid coupling (flanged type).
9. Design and drawing of a flexible coupling (pin-bush type)
10. Design and drawing of a leaf spring for an automobile.
11. Design and drawing of a helical spring for a given application.
12. Product development design problems/exercise.

Note:

1. Students may be advised to use design data book for design.
2. Drawing shall be made wherever necessary on small drawing sheets.

DYNAMICS OF MACHINES LAB

IME-553

(Say minimum 8 experiments out of following)

w.e.f. Session 2014-15

L	T	P
0	0	3

1. Study of simple links/models/mechanisms.
2. Exp. On velocity acceleration.
3. Exp. On Cam.
4. Exp. On Governor.
5. Exp. On Critical speed of shaft (whirling of shaft).
6. Exp. On Gyroscope
7. Exp. On Balancing (static and dynamic)
8. Exp. On 4 Bar mechanism.
9. Exp. On Gears (tooth profile, interference etc).
10. Exp. On Gear trains.
11. Exp. On Brakes
12. Exp. On Clutch
13. Exp. On Synthesis of planner linkages
14. Exp. On Mechanisms
15. Exp. On Vibration (spring)
16. Exp. On Vibration (beam)
17. Exp. On Vibration (torsional)

MANUFACTURING SCIENCE –II LAB

IME-554

(Say minimum 8 experiments out of the following)
(or such experiments along with study of the machines/processes)
w.e.f. Session 2014-15

L	T	P
0	0	3

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine.
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface grinding machine.
7. Drilling holes on drilling machine and study of twist drill.
8. Study of different types of tools and their angles and materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and their uses.
11. Gas welding experiment.
12. Arc welding experiment.
13. Resistance welding experiment.
14. Soldering and Brazing experiment.
15. Experiment on unconventional machining.
16. Experiment on unconventional welding.
17. Experiment on TIG/MIG welding.
18. Macro and Microstructure of welds and HAZ.

HEAT AND MASS TRANSFER LAB

IME-555

(Say minimum 8 experiments out of the following or such experiments)

w.e.f. Session 2014-15

L	T	P
0	0	3

1. Conduction: Composite wall experiment
2. Conduction: Composite cylinder experiment
3. Convection: Pool boiling experiment
4. Convection: Experiment on heat transfer from tube-natural convection
5. Convection: Heat pipe experiment
6. Convection: Heat transfer through fin-natural convection
7. Convection: Heat transfer through tube/fin forced convection
8. Any experiment on Radiation such as on Stefan's law determination of emissivity, etc.
9. Any experiment on Radiation such as on solar collector etc.
10. Heat exchanger: Parallel flow experiment
11. Heat exchanger: Counter flow experiment
12. Any other suitable experiment such as on critical insulation thickness.
13. Conduction : Determination of thermal conductivity of fluids.
14. Conduction : Thermal Contact Resistance Effect.

RELIABILITY ENGINEERING
IEME-021
w.e.f. Session 2014-15

L T P
2 1 0

UNIT-I

Introduction:

Definition of reliability, types of failures, definition and factors influencing system effectiveness, various parameters of system effectiveness. **8**

UNIT-II

Reliability Mathematics:

Definition of probability, laws of probability, conditional probability, Bay's theorem; various distributions; data collection, recovery of data, data analysis Procedures, empirical reliability calculations. **8**

UNIT-III

Reliability:

Types of system- series, parallel, series parallel, stand by and complex; development of logic diagram, methods of reliability evaluation; cut set and tieset methods, matrix methods event trees and fault trees methods, reliability evaluation using probability distributions, Markov method, frequency and duration method. **8**

UNIT-IV

Reliability Improvements:

Methods of reliability improvement, component redundancy, system redundancy, types of redundancies-series, parallel, series - parallel, stand by and hybrid, effect of maintenance. **8**

UNIT-V

Reliability Testing:

Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards. **8**

Books Recommended:

1. R.Billintan & R.N. Allan,"Reliability Evaluation of Engineering and Systems", Plenum Press.
2. K.C. Kapoor & L.R. Lamberson,"Reliability in Engineering and Design", John Wiely and Sons.
3. S.K. Sinha & B.K. Kale,"Life Testing and Reliability Estimation", Wiely Eastern Ltd.
4. M.L. Shooman, "Probabilistic Reliability, An Engineering Approach", McGraw Hill.
5. G.H.Sandler,"System Reliability Engineering", Prentice Hall.

MAINTENANCE ENGINEERING & MANAGEMENT
IEME-022
w.e.f. Session 2014-15

L T P
2 1 0

UNIT-I

Introduction, operating life cycle, reliability, Failure data analysis, failure rate curve, hazard models, elements in series, parallel, mix, logic diagrams, improving reliability, redundancy-element, unit, standby, maintainability, availability, reliability and maintainability trade off. **8**

UNIT-II

Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency. **8**

UNIT-III

Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure. **8**

UNIT-IV

Break down maintenance planning, assignment model, waiting time models expected waiting time, minimum cost service rate, PERT. **8**

UNIT-V

Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management. **8**

Books:

1. Management of systems – R.N. Nauhria & R. Prakash.
2. Operations Research – Wangner.

INDUSTRIAL ENGINEERING

IEME-023

w.e.f. Session 2014-15

L	T	P
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UNIT –I

Introduction : Concept of Industrial Engineering, Functions of Industrial Engineering, Industrial Engineering techniques, Role of an Industrial Engineer. Applications of Industrial Engineering. 2

Production and Productivity :

Concept of production, production function, production system, Definition of productivity, Difference between productivity and production, Productivity, efficiency and effectiveness. Measurement of productivity, Types of productivity, productivity index, ways to improve productivity. 3

Work Study:

Definition and concept, objectives of work study, purpose and procedure of method study, Analysis of motions, micromotion study, Motion economy principles, Flow chart, Man-Machine chart, PMTS, work measurement, stop watch time study, performance rating, standard time and work sampling. 3

UNIT-II

Job Evaluation and Merit Rating :

Concept of job evaluation, job analysis, job description, job simplification, job evaluation methods, Definition and methods of merit rating, wage-incentive payment plans. 3

Plant Layout and Materials Handling:

Considerations in plant location, Definition of plant layout, types of layout, Principle of plant layout, Material, handling, Material handling equipments. 3

Production Planning and Control (PPC)

Objectives of PPC, Functions of PPC, production planning, steps in PPC, effectiveness of PPC system. 2

UNIT-III

Depreciation and Replacement :

Concept of depreciation and obsolescence, Classifications of depreciation, Methods of charging depreciation, Service life of an asset, Replacement of items which deteriorate with time. 3

Inventory Control :

Inventory, function of inventory, inventory costs, Deterministic inventory models. 2

Statistical Quality Control:

Introduction, Process control, Control charts, acceptance plan, acceptance sampling, single, Double and sequential Sampling plans, concept of average outgoing quality. 3

UNIT-IV

Organization :

Concept and importance of organization, Principles of organization, Organizational structure, Design of organization, Organization chart, Line organization, Line and staff organization, functional organization Manpower planning, Human relationships. 3

Industrial Ownership:

Introduction, Sole proprietor enterprise, partnership firm, joint stock company, Classification of company, Comparison of Public, Private and Joint sector, Cooperative organization. 3

Factory Legislation in India :

Importance and principles of Labour legislation, Factory Act, Payment of wages Act, Minimum wages Act, Workmen's compensation Act, Employee's State Insurance Act. **2**

UNIT-V

Break-Even-Analysis :

Introduction and purpose of BEA, Assumptions, Steps in BEA, Fixed Cost, Variable cost, Margin of safety, Angle of incidence, Profit volume graph. **3**

Linear Programming and Operations Research:

Definition of Linear Programming, Graphical method, Transportation problem (TP), Mathematical formulation and solution of Transportation problem. **2**

Brief Introduction of the Following Terms:

Concept of optimization, Concept of value engineering Total Quality Management, Management of Projects, Advance concepts in Management information systems with emphasis on ERP, Professional and business Ethics, Environmental pollution. **3**

Books:

1. Industrial Engineering: M.I. Khan, New-Age Int.
2. Industrial Engineering and Management: O.P. Khanna, Dhanpat Rai
3. Principles of Management, An Analysis of Management Function: H.Kontz and C.D. Donnel.
4. Manufacturing Management: J.Moore, Prentice Hall.

MECHATRONICS
IEME-024
w.e.f. Session 2014-15

L T P
2 1 0

UNIT-I

INTRODUCTION TO MECHATRONICS & SEMICONDUCTOR DEVICES

Historical perspective, key elements of mechatronics system.

Covalent bonds & doping material, PN junction, Zener diode, Tunnel diode, Schottky diode Power Supplies & active component. **8**

UNIT-II

ANALOG & DIGITAL ELECTRONICS

Number System, Minimization of Boolean expressions, Timing diagrams.

Combinational Logic Module : Adder, Subtractor, Multiplexer, Demultiplexer, Decoder & Encoder.

Sequential Logic Module : Flip flop (SR, JK, D, T & Master Slave), Counter (Synchronous)

Analog Electronics :Introduction to amplifier, Amplifier Basic Model, Different Amplifier (Inverting ,Noninverting, Summing, Integrator & Differentiator), Comparator, Sample hold circuit. **8**

UNIT-III

SENSORS AND ACTUATORS

Introduction to Sensor & different sensor (Distance, movement, time of flight, pressure measurement, temperature measurement & proximity sensor).

Actuators : Moving iron transducer, Solenoids, Servo motor, Kinematics chain, Gears, Cam mechanism, Different type of clutches. **8**

UNIT-IV

CONTROL THEORY

Introduction to Control Theory, Modeling in frequency & time domain, Transfer function, System response, zero, first & second order.system, Routh Hurwitz Stability criterion, Root locus, Bode plot **8**

UNIT-V

ROBOTIC SYSTEM

Types of robot, Robotic arm terminology, Robotic arm configuration, Robot system, Robotic manipulation kinematics, Robotic arm positioning concepts & Robotic arm path planning.

Introduction to reliability & reliability system. **8**

Books:

1. MAHALIK, “Mechatronics : Principles, Concepts And Applications”, McGraw Hill Education Private Limited, 2009.
2. Ryszard Jablonsk, “Recent Advances In Mechatronic”, Springer, 2008-2009.
3. Bolton, “Mechatronics : A Multidisciplinary Approach : Electronic Control Systems in Mechanical and Electrical Engineering”, Pearson, 4 Edition, 2010.