



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–III Second Year- Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	ENVIRONMENTAL ENGINEERING	ME-3011	4L-0T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1-Convey a clear idea of use of renewable and non-renewable energy sources, its impact on environment. The ability to apply the fundamental knowledge of science and engineering to assess environmental and health risk and its effect on ecosystem.

CO2-Ability to understand environmental laws and regulations to develop guidelines, procedures and processes for health and safety issues due to air pollution and sound pollution.

CO3-Ability to understand environmental laws and regulations to develop guidelines, procedures and processes for health and safety issues due to water pollution

CO4-Understand what are professional ethics and how do ethics affect the outcomes of environmental laws and regulations.

CO5-Understanding the basic and causes of climate and weather change, global warming, climate variability

Unit –I

Energy- Sources of Energy: Renewable & Non-Renewable, Fossil fuel, Biomass Geothermal, Hydrogen, Solar, Wind, hydal, nuclear sources.

Ecosystem – Segments of Environment: Atmosphere, hydrosphere, Lithosphere, biosphere. Cycles in Ecosystem – Water, Carbon, Nitrogen. Biodiversity: Threats and conservation,

Unit –II

Air Pollution & Sound Pollution - Air Pollution: Air pollutants, classification, (Primary & secondary Pollutants) Adverse effects of pollutants. Causes of Air pollution chemical, photochemical, Greenhouse effect, ozone layer depletion, acid Rain. Sound Pollution: Causes, controlling measures, measurement of sound pollution (deciblage), Industrial and non – industrial.

Unit –III

Water Pollution– Water Pollution: Pollutants in water, adverse effects. Treatment of Domestic & Industrial water effluent.

Soil Pollution – Soil Profile, Pollutants in soil, their adverse effects, controlling measures.

Unit –IV

Society, Ethics & Human values– Impact of waste on society. Solid waste management (Nuclear, Thermal, Plastic, medical, Agriculture, domestic and e-waste). Ethics and moral values, ethical situations, objectives of ethics and its study . Preliminary studies regarding Environmental Protection Acts , introduction to value education, self exploration, sanyam & swasthya.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Unit –V

Basics of climate and weather, global warming, climate variability;

Causes of climate change – natural and anthropogenic, greenhouse gases, carbon cycle;

Mitigation strategies – renewable energy, energy efficiency, afforestation and reforestation, carbon capture utilization and storage (CCUS), sustainable practices;

Adaptation strategies – climate-resilient infrastructure, agriculture adaptation, water management, disaster risk reduction;

Policies and global efforts – UNFCCC, IPCC, COP summits, Paris Agreement, Kyoto Protocol;

India's initiatives – National Action Plan on Climate Change (NAPCC), State Action Plans on Climate Change (SAPCC), green economy measures;

Sustainable Development Goals (SDGs) and climate action.

References:-

1. Harris, CE, Prichard MS, Rabin's MJ, "Engineering Ethics"; Cengage Pub.
2. Rana SVS ; "Essentials of Ecology and Environment"; PHI Pub.
3. Raynold, GW "Ethics in information Technology"; Cengage.
4. Svakumar; Energy Environment & Ethics in society; TMH
5. AK De "Environmental Chemistry"; New Age Int. Publ.
6. BK Sharma, "Environmental Chemistry" ; Goel Publ. House.
7. Bala Krishnamoorthy; "Environmental management"; PHI
8. Gerard Kiely, "Environmental Engineering" ; TMH
9. Miller GT JR; living in the Environment Thomson/cengage
10. Cunningham WP and MA; principles of Environment Sc; TMH
11. Pandey, S.N. & Mishra, S.P. Environment & Ecology, 2011, Ane Books , Pvt. Ltd, New Delhi
12. Joseph, B. Environmental Studies, 2009 Tata Mcgraw Hill, Edu India Ltd. New Delhi.
13. Gour R.R, Sangal, R &Bagaria, G.P. , Excel Books, A-45, Naraina Phase-I ,New Delhi.- 110028



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

Semester–III Second Year-

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	STRENGTH OF MATERIALS	ME-3021	3L-1T-2P	6

Course Outcomes: After studying this course, students will be able to, CO1-Students will be able to predict mechanical behavior of the member by determining the stresses, strains and deflections produced by the loads up to the elastic limit.

CO2- Students will be able to solve the stresses in determinate and indeterminate, homogeneous and composite bars under concentrated loads, self weight and thermal loads.

CO3- Students will be proficient to construct Shear Force and Bending Moment diagrams for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load and couple.

CO4-Students will be able to determine bending and shear stresses in machine elements.

UNIT - I

STRESS AND STRAIN: Definition, Stress- strain, tensile & compressive stresses, shear stress- Elastic limit, Hooke's Law Poisson's Ratio, modulus of elasticity, modulus of rigidity, bulk modulus, yield stress, ultimate stress, factor of safety, state of simple shear, relation between elastic constants, Volumetric Strain, Volumetric strain for tri-axial loading, Deformation of tapering members, Deformation due to self weight, bars of varying sections, composite sections, temperature. Stress Mechanical properties of materials: Ductility, malleability, hardness, toughness, fatigue, creep; behavior of materials under tension, compression, bending, shear; ductile and brittle materials, failure of MS and Intension and torsion

UNIT - II

COMPOUND STRESSES: introduction, 3.2 Stress components on inclined planes, 3.3 General two- dimensional stress system, 3.4 Principal planes and stresses, 3.5 Mohr's circle of stresses. 3.6 Thin cylinders subjected to pressure, change in length, diameter and volume, 3.7 Thick cylinders - Lamé's equations (excluding compound cylinders).

UNIT - III

STRESSES IN BEAMS: Theory of pure Bending, Assumptions, Flexural formula for straight beams, moment of resistance, bending stress distribution, Section moduli for different sections, beams for uniform strength, Flitched beams, Principle axes, Principle



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

moment of inertia Direct & Bending Stresses: Core of Section, Chimneys subjected to wind pressure SHEAR STRESS IN BEAMS: Distribution of shear stress, across plane sections used commonly for structural purposes, shear connectors

UNIT - IV

BENDING : pure bending, symmetric member, deformation and stress, bending of composite sections, eccentric axial loading, shear force and BM diagram, relationship among load, shear and BM, shear stresses in beams, strain energy in bending, deflection of beams, equation of elastic curve, Macaulay's method and Area moment method for deflection of beams.

UNIT -V

TORSION: Torsion of circular shafts- solid and hollow, stresses in shaft when transmitting power, shafts in series and parallel. Torsion in shafts: stresses in a shaft, deformation in circular shaft, angle of twist, stepped-hollow, thin walled-hollow transmission shafts Leaf springs; helical springs, open and closed coil, stress in spring wire, deflection of helical spring, springs in series and parallel.

Text Book/References Books/ Websites

1. Andrew Pytel, Ferdinand L. Singer; Strength of Material; Addison Wesley Longman Inc.
2. G.H. Ruder; Strength of Material; ELBS with Macmillan third edition.
3. B.K. Sarkar, Strength of Material ; Tata McGraw hill New Delhi.
4. Dr. R. K. Bansal; A Text Book strength of Material; Laxmi Publication New Delhi.
5. S Ramamrutham, Strength of Material; Dhanpat Rai & Publication New Delhi.
6. R.S. Khurmi; Strength of Material; S.Chand Company Ltd. Delhi

Suggested List of Laboratory Experiments (Expandable):-

1. Study and demonstration of Universal Testing Machine & its attachments.
2. Drawing sheet on shear force & bending Moment diagrams for a given loading (At least four problems.).
3. Tension Test on mild steel, Aluminum & compression test on cast iron on UTM.
4. Direct Shear Test of mild steel on Universal Testing Machine.
5. Brinell Hardness Test on Mild Steel.
6. Rockwell hardness Test on Hardened Steel.
7. Izod & Charpy - Impact tests of a standard specimen.
8. Torsion Test on Mild steel bar.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–III Second Year-

Course Content & Grade

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ME	MANUFACTURING PROCESSES	ME-3031	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1-Select appropriate Manufacturing Processing to manufacture any component.

CO2-Interpret foundry practices like pattern making, mold making, Core making and Inspection of defects.

CO3-Differentiate various metal forming processes such as Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.

CO4-Classify different plastic molding processes, Extrusion of Plastic and Thermoforming.

UNIT-I

Patterns and Pattern making Introduction to Foundry - Steps involved in casting, advantages, limitations and applications of casting process. Pattern types, allowances for pattern, pattern materials, color coding and storing of patterns Moulding methods and processes-materials, equipment, Moulding sand ingredients, essential requirements, sand preparation and control, testing, cores and core making. Design considerations in casting, gating and Riser - directional solidification in castings, Metallurgical aspects of Casting

UNIT- II

Casting Processes Sand castings, pressure die casting, permanent mould casting, centrifugal casting, precision investment casting, shell Moulding, CO₂Moulding, continuous casting-squeeze casting, electro slag casting, Fettling and finishing, defects in Castings, Casting of non-ferrous materials Melting, Pouring and Testing.

Melting furnaces crucibles oil fired furnaces-electric furnaces-cupola, selection of furnace, calculation of cupola charges-Degasification, inoculation, pouring techniques casting defects and Inspection of castings.

UNIT- III

Basic Joining Processes Types of welding-gas welding, -arc welding,-shielded metal arc welding, GTAW, GMAW, SAW, ESW-Resistance welding (spot, seam, projection, percussion, flash types)-atomic hydrogen arc welding-thermit welding, Flame cutting - Use of Oxyacetylene, modern cutting processes, arc cutting,

UNIT- IV

Special Welding Processes Soldering:- Brazing and braze welding and their application., welding of special materials – Stainless steel, Aluminum etc. weldability of cast iron, steel, stainless steel, aluminum alloys. Introduction to Electron beam and Laserwelding.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

UNIT-V

Design of Weldments: Welding symbols-Positions of welding-joint and groove design-weld stress- calculations-design of weld size, estimation of weld dilution, heat input, effect of welding parameters preheating, and post heating temperature: Selection of electrodes, flux etc. Weldments Testing and Metallurgy Inspection of welds – destructive and non-destructive testing methods, Defects in welding- causes and remedies, -effect of gases in welding-fatigue failure inWeldments.

Text Book/References Books/ Websites

1. Steven R. Schmid ; Manufacturing Engineering Technology, Steven R Schmid and Other Publication.
2. S.P Nayak; Metallurgy for Engineering; McGraw Hill Publication Co.Ltd.
3. Dr. Abdul Mubeen ; Metallurgical Testing, Khanna Publication.
4. Hazara choudhary Workshop Technology- Vol-II; Media Promoters & Publishers Pvt. Ltd.
5. R.K.Jain; Production Technology, Khanna Publications.

Suggested List of Laboratory Practical (Expandable): Nil



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–III Second Year- Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	THERMODYNAMICS	ME-3041	3L-1T-2P	6

Course Outcomes: After studying this course, students will be able to,

CO1-Students will be able to explain the basic principles and applications of the thermodynamics to the various real life systems.

CO2-Students will be able to describe fundamental laws of thermodynamics.

CO3-Students will be able to apply the concepts such as Entropy, Energy Balance also the calculations of heat, work and other important thermodynamic properties for various ideal gas processes.

CO4-Students will be able to estimate performance of various thermodynamic gas power cycles and gas refrigeration cycle and availability in each case.

UNIT - I

Basic concepts of Thermodynamics:- Property, Equilibrium, State, Process, Cycle, Zeroth law of thermodynamics, statement and significance, concept of an Ideal gas, Gas laws, Avogadro's hypothesis, Heat and work transfer. First law of thermodynamics- Statement of first law of thermodynamics, first law applied to closed system, first law applied to a closed system undergoing a cycle, processes analysis of closed system, flow process, flow energy, steady flow process, Relations for flow processes, limitations of first law of thermodynamics.

UNIT - II

Second law of thermodynamics:- Heat engine, heat reservoir, Refrigerator, heat pump, COP, EPR, Available energy, Carnot's theorem, Carnot's cycle, efficiency of Carnot's cycle, statement of second law Reversible and irreversible processes, consequence of second law, Entropy, Entropy change for ideal gas, T-S diagrams, Availability and Irreversibility. Gibbs and Helmholtz functions

UNIT - III

Real gas:- Deviation with ideal gas, Vander-wall's equation, evaluation of its constants, limitations of the equation. The law of corresponding states Compressibility factor, Generalized compressibility chart, P-V-surface of a Real gas, Thermodynamics relations, Maxwell relations and their applications.

UNIT - IV

Pure Substance:- Phase, Phase-transformations, formation of steam, properties of steam, PVT surface, HS,TS,PV,PH,TV diagram, processes of vapor measurement of dryness fraction, Use of steam table and Mollier chart.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

UNIT - V

Air standard cycles:- Carnot, Otto, Diesel, Dual cycles and there comparison, two stroke and four stroke engines, Brayton cycle, non reactive gas mixture, PVT relationship, mixture of ideal gases, properties of mixture of ideal gases, internal energy, Enthalpy and specific heat of gas mixtures, Enthalpy of gas mixtures.

Text Book/References Books/ Websites

1. P.K.Nag; Engineering Thermodynamics;TMH
2. Van GJ; Thermodynamics; JohnWylen
3. Cengel Y; Thermodynamics; TMH
4. Arora CP; Thermodynamics; TMH
5. Thermal Engineering by RYadav
6. Engineering Thermodynamics by Omkar Singh New AgeInternational.
7. Engineering Thermodynamics by RathaKrishanan PHI India Pvt.Ltd.
8. Engineering Thermodynamics by M. Achuthan, PHIIndia.

Suggested List of Laboratory Experiments (Expandable):-

1. To study working of Gas turbines by models and to identify various processes of Brayton Cycle
2. Numerical on vapour processes and ideal gas processes (minimum two problems on each)
3. Study of fuel pump
4. Study fuel injector
5. Study of Carburetor
6. Study of steam turbine.
7. To Study the Rankine Cyclar Power Plant
8. Study of the processes of Heat Engine
9. To investigate the first law and Second law of thermodynamic using heat Engine

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R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–III Second Year-

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	VALUE EDUCATION	ME-3051	4L-0T-2P	6

Course Outcomes: After studying this course, students will be able to CO1-Students will understand the importance of value based living.

CO2-Students will gain deeper understanding about the purpose of their life.

CO3-Students will understand and start applying the essential steps to become good leaders

CO4-Students will emerge as responsible citizens with clear conviction to practice values and ethics in life

Chapter 1

Value Education

Concepts of Values-Definition and Types of values –The need for Education in values- Challenges for Value adoption-Character development-Vision of a better world

Chapter 2

Inculcation of values

Classification of values- Personal Values-Family Values-Social Values-Spiritual values-Benefits of value adoption

Chapter 3

Values for Professional excellence

Definition-Purpose-implementation-situations to adopt-reflection questions-quotable quotes of Active listening-Decision making-Determination-Perseverance-Discipline-Responsibility

Chapter 4

Business ethics

Ethics and Entrepreneurship- Professional Ethics –Ethical choices- Resolving Ethical Dilemmas-Leadership and Social Responsibility- Corporate Social Responsibility

Chapter 5

Quality of Life

Dealing with change-Trends, Organizations and the Individual-Self and the world-Quality from within- Relating to others-The dynamics of personal powers

Chapter 6

Exploring the self

True Identity-Anatomy of the self-The cyclic processes within the self-States of the awareness-Innate and Acquired qualities-Empowering the self

Chapter 7

Understanding Self-Esteem

Know self-esteem-Understanding the self-Components of self-esteem-Association with self- esteem- Levels of self-esteem-Reflection exercises

Chapter 8

Principles of living

Be introspective-Be an observer-Being optimistic-Appreciate differences-Don't compare yourself with others-Live at present.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Chapter 9

Practical Meditation

Why meditate?-Soul consciousness-The supreme-Karma-Timeless dimension-The eight powers

Chapter 10

Exercises for Practice

Quiet reflection- Practice introversion-Being an observer-Stand back and observe -Self awareness (Soul consciousness)-Experiencing Body free stage-Reflect on original qualities-Visualize the Divine- Think attributes of the Supreme-Developing a living relationship-Surrender to God>Create Good wishes for all- Visualization in Meditation: Orbs of Light-The forest-The Balloon

Every chapter will have 1.Objectives 2.Introduction 9. Summary 10. Glossary and 11. Suggested Reading apart from the CONTENT as referred above

Text Book/References Books/ Websites:

1. Value,Spirituality and Consciousness Development; Rajyoga Education & Research Foundation (Education Wing)
2. Miles; Techniques of Value analysis and engineering; McGraw Hill Publication.
3. Heller Pub; Value Management; Addison Wesley.
4. Loughton; Value Analysis and Value; Pitman Publication

Suggested List of Laboratory Experiments (Expandable):-

1. To Study of Ethics and Value Education
2. To Study Education for Values in Engineering College – A Framework
3. To Study Approaches and Strategies of Value Education
4. To Study Key Dimensions for Mapping Value Contexts in Engineering College
5. To Study Guidelines for Implementation and Evaluation of Value Education
6. To Study Experiences and Innovations: Value Education in RKDF University, Bhopal
7. To Study Principles of Excellence in Value Education



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–III Second Year- Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	COMPUTER AIDED DESIGN	ME-3061	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to

CO1-Ability to create fully constrained solid models that can be quickly modified using standard software tools.

CO2-Ability to use, identify and explain standard features in solid modeling including protrusions, revolutions, cutouts, and patterns

CO3-Ability to use standard software tools to create engineering drawings, or other documents, to fully describe the geometries and dimensions of parts, as well as to document assemblies according to standard practice

CO4-Ability to use standard software tools to create part assemblies and check for clearances.

Introduction to CAD

Introduction to Computer Aided Drafting software for 2D and 3D Modeling, benefit, software's basic commands of drafting entities like line, circle, polygon, polyhedron, cylinders; transformations and editing commands like move, rotate, mirror, array.

- Practicing commands under Draw and Dimension Menu
- Practicing commands under Modify Menu.
- Practicing commands under Tool Menu.
- Practicing commands under Format Menu.
- Practicing commands under Express Menu.

Text Book/References Books/ Websites: Nil

Suggested List of Laboratory Experiments (Expandable):-

1. To Study The Introduction to CAD
2. To Study ACAD – Basics
3. To Study 2 - D Figures Using ACAD
4. To Study Isometric Drawings Using ACAD
5. To Study 3-D Figures Using ACAD



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–IV Second Year-

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	ENGINEERING MATHEMATICS-III	ME- 4011	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1-Understand and apply knowledge of complex variables and integral for real life and engineering problems.

CO2-Able to apply the knowledge of various numerical methods and interpolation CO3-Identify, formulate and solve engineering problems.

CO4-Understand and apply the concept of probability distribution to engineering problems

Unit

Fourier series: Introduction of Fourier series, Fourier series for Discontinuous functions, and Fourier series for even and odd function. Laplace Transform: Introduction of Laplace Transform, Laplace Transform of Elementary functions, properties of Laplace Transform, Change of scale property, second shifting property, Laplace transform of the derivative, Inverse Laplace transform & its properties, Convolution theorem, Applications of L.T. to solve the ordinary differential equations.

Unit II

Difference Operators: -Interpolation (Newton Forward & Backward Formulae, Central Interpolation Formulae, a range's and divided difference formulae), Numerical Differentiation and Numerical Integration.

Errors & Approximations, Solution of Algebraic & Transcendental Equations (Regula Falsi, Newton-Raphson, Iterative, Secant Method), Solution of simultaneous linear equations by Gauss Elimination, Gauss Jordan, Crout's methods, Jacobi's and Gauss-Seidel Iterative methods

Unit IV

Solution of Ordinary Differential Equations (Taylor's Series, Picard's Method, Modified Euler's Method, Runge-Kutta Method, Milne's Predictor & Corrector method), Correlation and Regression, Curve Fitting (Method of Least Square).

Unit

Concept of Probability: Probability: Binomial, Poisson's, Continuous Distribution: Normal Distribution, Testing of Hypothesis | Students t-test, Fisher's z-test, Chi-Square Method.

References

- (i) Higher Engineering Mathematics by B S Grewal, Khanna Publication
- (ii) Advance Engineering Mathematics by D.G. Guffy
- (iii) Mathematics for Engineers by S. Arumugam, SCITECH Publication
- (iv) Engineering Mathematics by S Sastri. P.H.I.
- (v) Numerical Methods for Scientific and Engg. Computation by MK Jain, Iyengar and RK Jain, New Age International Publication
- (vi) Mathematical Methods by KV Suryanarayan Rao, SCITECH Publication



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–IV Second Year- Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	KINEMATICS AND THEORY OF MACHINES	ME- 4021	3L-1T-2P	6

Course Outcomes:-After studying this course, students will be able to,
CO1-Kinematics & Theory of Machines I includes study of velocity, acceleration and force analysis of different mechanisms, power transmitting elements.
CO2-The students will be conversant with commonly used mechanism for industrial application.
CO3-The students will get competency in drawing velocity and acceleration diagram for simple and complex mechanism
CO4-Students will get analytical competency in solving kinematic problems using complex algebra method

UNIT - I

Introduction:-Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanism, Grubler's equation, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain Velocity in Mechanisms Velocity of point in mechanism, relative velocity method, Velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, Rubbing velocity at a pin joint, Instantaneous center method, Types & location of instantaneous centers, Kennedy's theorem, Velocities in four bar mechanism & slider crank mechanism

UNIT - II

Acceleration in Mechanisms:-Acceleration of a point on a link, Acceleration diagram, Coriolis component of acceleration, Crank and slotted lever mechanism, Klein's construction for Slider Crank mechanism Mechanisms with Lower Pairs Pantograph, Exact straight line motion mechanisms-Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms-Grass-Hopper, Watt and Tchebicheff mechanisms, Analysis of Hooke's joint, Davis and Ackermann steering gear mechanisms.

UNIT - III

Friction:-Laws of friction, Friction on inclined plane, Efficiency on inclined plane, Friction in journal bearing-friction circle, Pivots and collar friction uniform pressure and uniform wear, Belt and pulley drive, Length of open and cross belt drive, Ratio of driving tensions for flat belt drive, centrifugal tension, condition for maximum power transmission, V belt drive Brakes & Dynamometers Shoe brake, Band brake, Band and Block brake, Absorption and transmission type dynamometers

UNIT - IV

Cams and Followers: – Classification & terminology, Cam profile by graphical methods with knife edge and radial roller follower for uniform velocity, simple harmonic and parabolic motion of followers, Analytical methods of cam design – tangent cam with roller follower and circular cams with flat faced follower.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

UNIT - V

Gears & Gear Trains:-Classification & terminology, law of gearing, tooth forms & comparisons, Systems of gear teeth, Length of path of contact, contact ratio, interference & under cutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, Sun and planet gear.

Text Book/References Books/ Websites:

1. Theory of Machines – Thomas Bevan
2. Theory of Machines and Mechanisms- Shigley
3. Theory of Machines and Mechanisms-Ghosh & Mallik
4. Theory of Machines and Mechanisms- Rao & Dukkipati
5. Theory of Machines-S.S.Rattan
6. Kinematics of Machines-Dr. Sadhusingh
7. Mechanics of Machines – V.Ramamurti
8. Theory of Machines – Khurmi & Gupta
9. Theory of Machines – R. K. Bansal
10. Theory of Machines – V. P. Singh
11. Theory of Machines – Malhotra & Gupta

Suggested List of Laboratory Experiments (Expandable):-

1. To study of various types of Kinematic links, pairs, chains and Mechanisms.
2. To study of inversions of 4 Bar Mechanisms, Single and double slider crank mechanisms.
3. To study of plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
4. To find coefficient of friction between belt and pulley.
5. To study of various type of cam and follower arrangements.
6. To study of plot follower displacement vs. cam rotation for various Cam Follower systems.
7. To study of generate spur gear involutes tooth profile using simulated gear shaping process.
8. To study of various types of gears – Helical, cross helical worm, bevel gear.
9. To study of various types of gear trains – simple, compound, reverted, epicycle and differential.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–IV Second Year- Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	POWER PLANT ENGINEERING	ME-4031	4L-0T-2P	6

Course Outcomes:-After studying this course, students will be able to,

CO1-Students will be able to understand basic knowledge of Different types of Power Plants, site selection criteria of each one of them and understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc.

CO2-Students will be able to select the suitability of site for a power plant and will be able to calculate load factor, capacity factor, average load and peak load on a power plant. Students will also be able to propose ash handling, coal handling method in a the thermal power plant.

CO3-Students will be able to understand the working of Diesel & Gas Turbine Power plant.

CO4-Students will be able to design the Power Plant Instrumentation and understand Environmental Impact

Unit - I

Introduction Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant

Power plant economics and selection:-Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plants election.

Unit - II

Steam power plant:-General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizes and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating , flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

Unit - III

Diesel power plant:-General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam powerplant.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Gas turbine power plant:-Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine powerplant

Unit - IV

Nuclear power plant:-Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants. Hydroelectric station Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. Non-Conventional Power Plants Introduction to non-conventional power plants (Solar, wind, geothermal, tidal) etc.

Unit - V

Electrical system:-Generators and generator cooling, transformers and their cooling, bus bar, etc. Instrumentation Purpose, classification, selection and application, recorders and their use, listing of various control rooms. Pollution due to power generation.

Text Book/References Books/ Websites:

1. "Power Plant Engineering" F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
2. Power Plant Engineering" Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi
3. "Power Plant Technology" El-Vakil, McGrawHill.
4. Power Plant Engineering by P.K. Nag, Tata McGrawHill.
5. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub. House.

Suggested List of Laboratory Experiments (Expandable):-

1. To study of low pressure boilers and their accessories and mountings.
2. To study of high pressure boilers and their accessories and mountings.
3. To study of prepare heat balance sheet for given boiler.
4. To study of the working of impulse and reaction steam turbines.
5. To find dryness fraction of steam by separating and throttling calorimeter.
6. To find power output & efficiency of a steam turbine.
7. To study and find volumetric efficiency of a reciprocating air compressor.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

Semester–IV Second Year-

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	MATERIAL SCIENCE & METTALURGY	ME-4041	4L-0T-2P	6

Course Outcomes:-After studying this course, students will be able to,

CO1-Be able to apply core concepts in Materials Science and Metallurgy to solve engineering problems. CO2-Interpret about material fundamental and material processing. CO3-Figure out the different mechanical properties of material by studying different destructive and non- destructive testing.

CO4-Acknowledge the importance of surface modification and study the different surface modification methods.

UNIT - I

Engineering Materials:-Classification of plain carbon steels; composition, properties & applications of low, medium & high carbon steels. Alloy steels: Free cutting steels; structural steel, spring steel, tool steel, high speed steels stainless steels. Effects of alloy element on properties of steels. Type of Cast irons: composition, properties & applications of each. Properties of aluminum; alloy of aluminum, (wrought & cast alloys), properties of copper, copper alloys (Brasses & Bronzes); Introduction and application to nano materials. Powder metallurgy- property and application.

UNIT - II

Plastic Deformation of Metals:-The tensile stress strain curve, Deformation by slip & by twinning, Dislocation theory, Theory of work hardening its effect on properties of metals, Recovery, Recrystallisation and grain growth; Hot and cold working of metals and their effect on mechanical properties, annealing, Introduction to creep, fracture and fatigue behavior of metals.

UNIT - III

Crystal Structure:-Mechanism of crystallization; unit cells, space lattice and lattice constants; Crystal systems, and Bravias Lattices; Body centered cubic, Face centered cubic and Hexagonal closed packed structure; Miller indices for planes and directions; Crystal imperfections; point defects, line defects and surface defects. Manufacturing and properties of refractory (acid, basic and natural).

UNIT - IV

Heat Treatment of Steels:-Definition, principle, and purpose of heat



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

treatment. Description of heat treatment methods: Hardening, Annealing, Normalizing, Tempering and case hardening with microstructure changes. Martempering & Austempering, Hardenability and its determination. Precipitation Hardening. Isothermal Transformation of steel, Transformation on continuous cooling, Critical cooling rate, Heat treatment furnace.

UNIT - V

Phase Diagrams:- Definition of phase, Equilibrium cooling of pure metals and binary alloys. Hume Rothery rule for solid solubility, Types of solid solution, Eutectic, Eutectoid and Peritectic reactions, Allotropy of iron, Iron-Iron carbon equilibrium diagram, relationship equilibrium diagram and properties of alloy.

Text Book/References Books/ Websites:

1. Introduction to physical Metallurgy by Sidney H. Avner,.- TataMcGraw-Hill
2. Material Science & Metallurgy for Engineering by Dr.V.D. Kodgire.- Everest Pub.House, Pune.
3. Materials Science & Engineering by V. Raghavan.- Prentice Hall of India, NewDelhi.
4. Heat Treatment principles & Technology by T.V. Rajan, O.P.sharma.-
5. Engineering Metallurgy Part –I by Raymond A. Higgins,ELBS.
6. Introduction to Engineering materials by B.K.Agrawal.-
7. Physical Metallurgy for Engineering by Donald S. Clark &Willbur R. Varney,EWP.
8. Engineering Material and Metallurgy by R.K. Rajput / SChand
9. Material Science & Metallurgy for Engineering by O.P. Khanna, DhanpatRai

Suggested List of Laboratory Experiments (Expandable):-

1. To study of Iron Carbon Equilibrium Diagram of different phases.
2. To study of TTT(Temperature, Time, Transformation) Diagram.
3. To study of different types of crystal structure like HCP, BCC, FCC etc.
4. To study of Mechanical properties of materials.
5. To different types of crystal defects in materials.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–IV Second Year- Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	MACHINE DRAWING	ME -4051	3L-1T-2P	6

Course Outcomes:- After studying this course, students will be able to, CO1- Able to understand product symbols, weld symbols, pipe joints CO2- Understand orthographic projections of machine elements CO3- Understand isometric projections of machine elements CO4- Understand detailed assembly drawings of Plummer block, Tailstock, Welded joints, tool head of shaper.

UNIT – I

Introduction:- Principles of Drawing, Requirements of production drawing, Sectioning and conventional representation, Dimensioning, symbols of standard tolerances, Machining Symbols such as external and internal threads, slotted heads, square ends, and flat radial ribs, slotted shaft, splined shafts, bearings, springs, gears. Introduction to Compute Aided Drafting software for 2D and 3D Modeling.

UNIT – II

Fasteners:- Various types of screw threads, types of nuts and bolts, screwed fasteners, welding joints and riveted joints.

UNIT - III

Assembly Machine Drawing:- Basic concept, plotting technique, assembly and blow up of parts, bill of materials, product data; Cotter and Knuckle joints, pedestal and footstep bearings, crosshead, stuffing box, IC engines parts - piston and connecting rods; lathe machine parts.

UNIT - IV

Pipe and Pipe Fittings:- flanged joints, spigot and socket joint, union joint, hydraulic expansion joint. Couplings: Solid or Rigid Coupling, Protected Type Flange coupling, muff coupling, Oldham, universal coupling, cone friction clutch, free hand sketch of single plate friction clutch.

Text Book/References Books/ Websites:

1. Ajit Singh, Machine Drawing (including Auto CAD), Tata McGrawHill
2. N.D. Bhatt, Machine Drawing, Charotar publications
3. N. Sidheshwar, Machine Drawing, Tata McGrawHill.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

4. P.S. Gill, Machine Drawing, BD Kataria and Sons.
5. V Lakshmi Narayanan and Mathur, Text -book of Machine Drawing
6. Narayana and Reddy; Machine Drawing; New age, Delhi.
7. Dr. K. K. Dewadi, Machine Drawing, Dhanpat Rai

Suggested List of Laboratory Experiments (Expandable):-

1. To Study of Conversion of pictorial views.
2. To Study of Sectional views of machine component.
3. To Study of Drawings of standard components.
4. To Study of Drawings of standard assemblies with components.
5. To Study of Drawings of small assemblies with components.
6. To Study of Detailed drawings of assembly.
7. To Study of Preparation and explanation on production drawings.
8. Assembly on Machine Drawing on Cutter joint.
9. Assembly on Machine Drawing on Knuckle Joint.
10. Assembly on Machine Drawing on pedestal and footstep bearings.
11. Assembly on Machine Drawing on crosshead.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–IV Second Year- Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	JAVA PROGRAMMING	ME -4061	0L-0T-2P	2

Course Outcomes:-After studying this course, students will be able to,

The student should be able to use an integrated development environment to write, compile, run, and test simple object-oriented Java programs. Read and make elementary modifications to Java programs that solve real-world problems.

UNIT-I

Basic Java Features:- C++ Vs JAVA, JAVA virtual machine, Constant & Variables, Data Types, Class, Methods, Objects, Strings and Arrays, Type Casting, Operators, Precedence relations, Control Statements, Exception Handling, File and Streams, Visibility, Constructors, Operator and Methods Overloading, Static Members, Inheritance: Polymorphism, Abstract methods and Classes

UNIT-II

Java Collective Frame Work:- Data Structures: Introduction, Type-Wrapper Classes for Primitive Types, Dynamic Memory Allocation, Linked List, Stack, Queues, Trees, Generics: Introduction, Overloading Generic Methods, Generic Classes, Collections: Interface Collection and Class Collections, Lists, Array List and Iterator, Linked List.

Vector Collections Algorithms:- Algorithm sorts, Algorithm shuffle, Algorithms reverse, fill, copy, max and min Algorithm binary Search, Algorithms add All, Stack Class of Package java. Util, Class Priority Queue and Interface Queue, Maps, Properties Class, Un-modifiable Collections.

UNIT-III

Advance Java Features:- Multithreading: Thread States, Priorities and Thread Scheduling, Life Cycle of a Thread, Thread Synchronization, Creating and Executing Threads, Multithreading with GUI, Monitors and Monitor Locks. Networking: Manipulating URLs, Reading a file on a Web Server, Socket programming, Security and the Network, RMI, Networking, Accessing Databases with JDBC: Relational Database, SQL, MySQL and Oracle

UNIT-IV

Advance Java Technologies Servlets:- Overview and Architecture, Setting Up the Apache Tomcat Server, Handling HTTP get Requests, Deploying a web Application, Multitier Applications, Using JDBC from a Servlet, Java Server Pages (JSP): Overview, First JSP Example, Implicit Objects, Scripting, Standard Actions, Directives, Multimedia: Applets and Application: Loading, Displaying and Scaling Images, Animating a Series of Images, Loading and playing Audio clips



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

UNIT-V

Advance Web/Internet Programming (Overview):- J2ME, J2EE, EJB, XML.

References

1. Deitel&Deitel, "JAVA, How to Program"; PHI, Pearson.
2. E. Balaguruswamy, "Programming In Java"; TMH Publications
3. The Complete Reference: Herbert Schildt, TMH

List of Program to be perform (Expandable)

1. Installation of J2SDK
2. Write a program to show Concept of CLASS in JAVA.
3. Write a program to show Type Casting in JAVA.
4. Write a program to show How Exception Handling is in JAVA.
5. Write a Program to show Inheritance.
6. Write a program to show Polymorphism.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–IV Second Year-

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	DYNAMICS OF MACHINERY	ME-5011	3L-1T-2P	6

Course Outcomes: After studying this course, students will be able to,

CO1-The students will get competency in graphical and analytical method for solving problems in static and dynamic force analysis.

CO2-The students will get competency in conducting laboratory experiments for finding moment of inertia of rigid bodies, verification of displacement relation for Hooke's joints, to measure power transmitted and absorbed by dynamometer and brakes respectively.

CO3-The students will be able to understand working principles of various types of brakes, clutches and dynamometers.

CO4-This subject will help students to apply knowledge in the field of automobile, aerospace and Novel industries, where mechanisms and moving members force and kinematic analysis and Power transmitting elements play vital role.

UNIT - I

Force analysis: – Rigid body dynamics in general plane equation-Equations of motion-Dynamic force analysis-Inertia force and inertia torque-D'Alembert's principle-The principle of superposition-Dynamic analysis in reciprocating engines-Gas forces-Equivalent masses-Bearing loads-Crank shaft torque- Turning moment diagrams-Fly wheels-Engine shaking forces-Cam dynamics-Unbalance, Spring, Surge and Windup.

UNIT - II

Mechanisms For Control:- Governors-Types-Centrifugal governors-Gravity controlled and spring controlled centrifugal governors-Characteristics-Effects of friction-Controlling force-Other governor mechanisms.

Gyroscopes:- Gyroscopic forces and torques-Gyroscopic stabilization-Gyroscopic effects in automobiles, ships and airplanes.

UNIT - III

Balancing:- Static and dynamic balancing-Balancing of rotating masses-Balancing a single cylinder engine- Balancing multi- cylinder engines-Partial balancing in locomotive engines- Balancing linkages- Balancing machines.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

UNIT - IV

Friction:- Frictional torque in pivots and collars by uniform pressure and uniform wear rate criteria. Boundary and fluid film lubrication, friction in journal and thrust bearings, concept of friction circle and axis, rolling friction.

Clutches: Single plate and multi plate clutches, Cone clutches.

UNIT - V

Belt Drives:- Velocity ratio, limiting ratio of tension; power transmitted; centrifugal effect on belts, maximum power transmitted by belt, initial tension, creep; chain and rope drives.

Brakes:- Band brake, block brakes, Internal and external shoe brakes, braking of vehicles. Dynamometer: Different types and their applications.

Dynamic Analysis of Cams:- Response of un-damped cam mechanism (analytical method), follower response analysis by phase-plane method, jump and cross-over shock.

Text Book/References Books/ Websites

1. SS Rattan; Theory of machines; TMH
2. AG Ambekar; Mechanism and Machine Theory; PHI.
3. CS Sharma; Purohit K; Theory of Mechanism and Machines; PHI
4. Thomas Bevan; Theory of Machines; Pearson/ CBS PUB Delhi.
5. Ghosh and Mallick, theory of machine & mechanism
6. T. V. Ramachandra; Management of Municipal Solid Waste; TERI press.

Suggested List of Laboratory Practical (Expandable):

1. To study of inversion of single and double slider crank mechanism.
2. To study various types of kinematics links, pair, chains & mechanisms.
3. To study of simple four bar linkage mechanism
4. To study of various types of gears
5. To study of various types of gear trains.
6. To study of various types of Cam & follower arrangements.
7. To study of different types of belts.
8. To find the co-efficient of friction between wooden block and glass surface with horizontal surfaces.
9. To find the co-efficient of friction between wooden block and glass surface with inclined surfaces.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year-
Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
B.E. ME	FLUID MECHANICS	ME- 5021	3L-1T-2P	4

Course Outcomes: After studying this course, students will be able to,

CO 1-Use of various properties in solving the problems in fluids.

CO 2-Use of Bernoulli's equation for solutions in fluids.

CO 3-Determination of forces drag and lift on immersed bodies.

CO 4-Analyze the performance of hydraulic machines.

CO 5-Analyze the performance of pumps.

UNIT – I

Basic Concepts and Properties of Fluid:- – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

UNIT – II

Fluid Kinematics And Fluid Dynamics:- Fluid Kinematics - Flow visualization - lines of flow

- types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net – fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's π Theorem- applications - similarity laws and models.

UNIT – III

Incompressible Fluid Flow:- Viscous flow - Navier - Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseuille's) - Hydraulic and energy gradient - flow through pipes - Darcy - weisback's equation - pipe roughness -friction factor- Moody's diagram-minor losses - flow through pipes in series and in parallel - power transmission - Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

UNIT – IV

Hydraulic Turbines:- Fluid machines: definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagram's - head and specific work - components of energy transfer - degree of reaction.

Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies - performance curve for turbines.

UNIT – V

Hydraulic Pumps:- definition and classifications Centrifugal pump: classifications, working principles. velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principles, indicator diagram, work saved by air vessels and performance curves - cavitations in pumps - rotary pumps: working principles of gear and vane pumps

Text Book/References Books/ Websites

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 1983.
2. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi (7th edition), 1995.
3. Vasandani, V.P., "Hydraulic Machines - Theory and Design", Khanna Publishers, 1992.
4. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5th edition), Laxmi publications (P) Ltd., New Delhi, 1995.
5. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
6. Ramamirtham, S., "Fluid Mechanics and Hydraulics and Fluid Machines", Dhanpat Rai and Sons, Delhi, 1998.
7. Som, S.K., and Biswas, G., "Introduction to fluid mechanics and fluid machines", Tata McGraw- Hill, 2nd edition, 2004.

Suggested List of Laboratory Practical (Expandable):

- 1 To determine the coefficient of impact for vanes.
- 2 To determine coefficient of discharge of an orifice meter.
- 3 To determine the coefficient of discharge of Notch (V and Rectangular types)
- 4 To determine the friction factor for the pipes.
- 5 To determine the coefficient of discharge of venturimeter.
- 6 To determine the coefficient of discharge, contraction & velocity of an orifice.
- 7 To verify the Bernoulli's Theorem.
- 8 To find critical Reynolds number for a pipe flow.
- 9 To determine the meta-centric height of a floating body.
- 10 To determine the minor losses due to sudden enlargement, sudden contraction and bends.
- 11 To show the velocity and pressure variation with radius in a forced vortex flow.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year-

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	ARTIFICIAL INTELLIGENCE & NEURAL NETWORK	ME- 5031(A)	4L-0T-2P	6

Course Outcomes:

After studying this course, students will be able to

CO1. Learn about importance of AI techniques. Adoption of Artificial Intelligence (AI) technologies is widely expanding in our society.

CO2. Know the exact application of AI Techniques. Such applications use AI techniques to interpret information from a wide variety of sources and use it to enable intelligent, goal-directed behavior.

CO3. Understand the working of Modern AI based systems. CO4. Know about sensors used in AI based systems.

Unit-1

Introduction:- Artificial Intelligence Main components and characteristics of AI (Feature Engineering, ANN, Deep Learning), Applications of AI, Advantages and disadvantages of AI, Goals of AI, Comparison of Programming of a System with AI and without AI, Challenges in AI, Programming languages preferably used in AI, Techniques/Algorithms used in AI, AI Software platforms, Future of AI.

Unit-2

Various types of production systems and search techniques:- Types of production systems, Characteristics of production systems, Study and comparison of breadth first search and depth first search. Techniques, other Search Techniques like hill Climbing, Best first Search. A* algorithm, AO* algorithms etc, and various types of control strategies.

Unit-3

Knowledge Representation and Probabilistic Reasoning:- Problems in representing knowledge, knowledge representation using propositional and predicate logic, comparison of propositional and predicate logic, Resolution, refutation, deduction, theorem proving, inferencing, monotonic and nonmonotonic reasoning. Probabilistic reasoning, Bayes' theorem, semantic networks, scripts, schemas, frames, conceptual dependency, fuzzy logic, forward and backward reasoning.

Unit-4

Game playing techniques:- Minimax procedure, alpha-beta cut-offs etc, planning, Study of the block world problem in robotics, Introduction to understanding and natural languages processing.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Unit-5

Introduction to Neural Network (NN):- Introduction, benefits of neural network, models of Neural Network.

Learning Processes: Various techniques used in learning, introduction to Artificial neural networks, common sense, reasoning, Convolution Neural Network, Feedforward Neural Network, Recurrent Neural Network, Multilayer perceptron, Architecture / Three Layers in Artificial Neural Networks, Implementation of ANN, Applications of ANN in images, signals and language some example of expert systems.

Text Book/References Books/ Websites

1. LRich E and Knight K, "Artificial Intelligence", TMH, New Delhi.
2. Nelsson N.J., "Principles of Artificial Intelligence", Springer Verlag, Berlin,
3. *Stuart Russell , Artificial Intelligence: A Modern Approach , 3rd Edition), Peter Norvig, PHI, ISBN13: 978-0136042594, ISBN-10: 0136042597
4. B. Yegnanarayana , Artificial Neural Networks PHI
5. Schalk of, Artificial Neural Networks. Mc Graw HILL Education
6. S. Haykin: Neural Networks- A Comprehensive Foundation, PHI Learning,

EVALUATION: Evaluation will be continuous and integral part of the class as well as through external assessment.

Suggested List of Laboratory Practical (Expandable):

1. To study the functions of Driverless car with help of neat sketch diagram.
2. To write any one programme with help of Python Language.
3. To study of machine Learning, Explain with help of any programme.
4. To Plot neuron output over the range of inputs with help of sketch. To study with help of AI and show case study of any one:
 - (a) Cancer Detection
 - (b) Character Recognition
 - (c) Iris Clustering.
6. To study of ANN and explain the commonly used ANN with help of Blok Diagram.
7. To study of Fuzzy logic Architecture.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year-
Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	Simulation And Modeling-I	ME- 5031(B)	4L-0T-2P	6

Course Contents:

Introduction to Modeling Software Packages like Solid Works, CATIA, ANSYS, Assembly of Sleeve and Cotter joint, Gib and Cotter joint/ Knuckle Joint/ Flanged Coupling, Assembly of Connecting Rod. Introduction to Simulation software Packages like ANSYS, Fluent, and etc. Various types of analysis. Structure analysis, Thermal analysis, Stress analysis, CFD analysis, FEM analysis, and their problem solving in actual situations.

List of Experiments (Expandable)

1. Introduction to CATIA software.
2. Introduction to ANSYS software.
3. Assembly of Sleeve and Cotter joint/ Gib and Cotter joint/ Knuckle Joint/ Flanged Coupling using CATIA.
4. Assembly of Connecting Rod using CATIA.
5. Stress analysis using ANSYS (examples: plate with a circular hole, rectangular L bracket, Axis-symmetric components, various types of beams, etc.)
6. Thermal stress analysis of a 2D component.
7. Conductive and convective heat transfer analysis of a 2D component.
8. CFD Simulation of various situations (example: Laminar pipe flow, Flat plate boundary layer, steady flow past a cylinder, Compressible flow in a Nozzle, Flow over an airfoil.)

Evaluation will be continuous an integral part of the laboratory class followed by the final external

viva/voce examination

References:

1. User manual of CATIA software.
2. User manual of ANSYS and Fluent software.
3. Chandrupatla, T.R. and Belegundu, A.D., Introduction to Finite Elements in Engineering, Prentice Hall of India Pvt. Ltd.
4. Zienkiewicz O C, The Finite Element Method, 3rd ed, Tata McGraw Hill.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year- Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	Alternate Automotive Fuels & Emissions	ME- 5031(C)	4L-0T-2P	6

Unit 1: Introduction Automobile Fuels:

Classification of Automobile alternative fuels(liquid, gaseous, hydrogen, LPG, CNG, Biogas etc.), Desirable characteristics of SI & CI engine alternative fuels, Rating of SI & CI engine fuels, Introduction to alternate energy sources. Like EV, hybrid, fuel cell and solar cars. Merits and demerits of various alternate fuels.

Unit 2: Liquid alternative fuels:

Vegetable Oils: Various vegetable oils for automobile engines, esterification, performance in engines, performance and emission characteristics, bio diesel and its characteristics. Alcohols: Properties as engine fuel, alcohols and gasoline blends, performance in automobile engine, methanol and gasoline blends.

Unit 3: Gaseous Fuels:

Biogas: Introduction to Biogas system, Process during gas formation, Factors affecting biogas formation. Usage of Biogas in SI engine & CI engine., Properties of Natural gas, Hydrogen gas, LPG & CNG as engine fuels, storage and handling, performance and safety aspects to all gaseous fuel, fuel metering systems.

Unit 4: Automobile emissions:

Types of automobile emissions, emission characteristics, formation of automobile emissions, mechanism of HC , CO and NO in SI engine, exhaust emission and factors affecting the emission, evaporative emission, crankcase emission, lead emission CI engine emissions: formation of smoke, factors affecting the smoke formation, unburned hydrocarbons, carbon monoxide, oxides of nitrogen, smog and comparison of diesel and petrol emissions.

Unit 5:Emissions Norms & Measurement:

Emission norms as per Bharat Standard up to BS – IV and procedures for confirmation on production. Demerits of automobile emission to environment. Types Of Catalytic Conversion, Measurement Techniques Emission Standards and Test Procedure NDIR,FID, Chemiluminescent analyzers, Gas Chromatograph, smoke meters, emission standards.

References:

1. J.B. Heywood. Internal combustion Engines, Wiley
2. Ganeshan V; Internal Combustion engines; TMH
3. Mathur M L & Sharma RP; A. Course in IC engines; DhanpatRai
4. R Yadav, Internal Combustion Engines



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

5. Halderman JD and Mitchell CD; Automotive Engines theory and servicing; Pearson
6. DomKundwar; Internal Combustion Engines; Dhanpat Rai Publications
7. Taylor GF; Internal Combustion Engines Theory & Practice; MIT Press
8. Richard Stone; Introduction to IC Engines; Society of Automotive Engr (Palgrave Mc Millan)

List of Experiment (Pl. expand it):

1. Study of alternative fuel for automobile.
2. Study of esterification of alternative fuels.
3. Study of blending different types of bio-diesel.
4. Measurement of smoke from automobile.
5. Study of different types of emissions.
6. Study of various techniques for NOx reduction.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year-

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	Hybrid electric Vehicle Design-I	ME- 5031(D)	4L-0T-2P	6

Course Outcomes: At the end of the course student will be able to

1. Identify EV concepts, EV configurations and various EV parameters for better understanding of the EV technology
2. Analyse the EV propulsion system and electric motors for vehicular applications & power electronics converters required for their control.
3. Analyse DC motor & induction motor drives and discuss methods for controlling them.
4. Elaborate various hybrid electric vehicle configurations and explain the power flow control in all HEV configurations
5. Identify different energy sources used in EV and analyse the various methods used in charging these energy sources

Unit 1 -Introduction: Electric Vehicle

History, Components of Electric Vehicle, Comparison with Internal combustion Engine : Technology, Comparison with Internal combustion Engine: Benefits and Challenges, EV classification and their electrification levels. EV Terminology

Unit - 2. Motor Torque Calculations For Electric Vehicle

Calculating the Rolling Resistance, calculating the grade resistance, Calculating The Acceleration Force, Finding The Total Tractive Effort, Torque Required On The Drive Wheel,

Unit- 3. Electric Vehicle Architecture Design

Types of Electric Vehicle and components, Electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV), Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV), Electrification Level of EV, Comparison of fuel vs Electric and solar power, Solar Power operated Electric vehicles

Unit- 4. Electric Drive and controller

Types of Motors, Selection and sizing of Motor, RPM and Torque calculation of motor, Motor Controllers, Component sizing

Physical locations, Mechanical connection of motor, Electrical connection of motor



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Unit-5

India Standard policy for electric and hybrid vehicle include Types of charging station, Modification of electric vehicle battery

REFERENCE BOOKS:

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel
4. Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
5. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

List of Experiments: -

1. IMC based control techniques
2. Model based control techniques for Electric Vehicle
3. Modelling, Control in State space for Electric Vehicle
4. Study of Observer design for Electric Vehicle
5. PI/PID controller for Electric Vehicle



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year-
Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
ME	SWAYAM/NPTEL-MOOC-1	ME. -5031(E)/Code as per SWAYAM/NPTEL-MOOC	4L-0T-0P	4

Guideline

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In perspective of the need to create synergist between the salient features of ‘anytime anywhere format of e-learning and traditional classrooms chalk and talk method to develop a unique content delivery mechanism which is responsive to learners’ needs and ensuring seamless transfer of knowledge across geographical boundaries. RKDF University proposes to incorporate MOOC courses delivered by SWAYAM/NEPTEL portal. Student can opt any courses from SWAYAM/NPTEL-MOOC courses as an elective Base on following condition

1. He/She has consulted and inform to the departmental coordinator regarding courses selection and mark obtain to him. No Subjected should be repeat from courses which is offer and courses which are selected.
2. He/She can opt from only courses which are not available from University.
3. Only enrollement in the courses and learning from it is free as this is a project



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

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4. To get Certificate from SWAYAM-NPTEL. The learner has to separately register and appear for a proctored exam at a fee as decided by host institution/Mooc of Rs. 1000/- Which be bearded by Student only.
5. If student successful appear in exam and obtain certificated of courses of 12 week course to earn 3 credits(As recommended by NPTEL) to suffice for required credit for the award of his/her degree.
6. The NPTEL recommended that an additional 1 credit may be awarded given by University. This credited can be given based on attendances, assignment and tutorial work submitted by the students.
7. All students would be motivated to take courses online with SWAYAM/NPTEL every semester to better prepared for the future so that they can cultivate the habilt of self-study online. The University propose to implement MOOC courses under Department. The University also made provision if student unable to get certificate He/She still be able to appear in the department elective courses and complete there degree



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year- Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	MECHATRONICS ENGINEERING	ME- 5041(A)	4L-0T-2P	6

Course Outcomes: After studying this course, students will be able to

CO 1 Identification of key elements of mechatronics system and its representation in terms of block diagram,

CO 2 Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital

CO3 Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller Interfacing of Sensors, Actuators using appropriate DAQ micro- controller

CO 4 Outline appropriate sensors and actuators for an engineering application.

Unit-1

Introduction:- Introduction to mechatronics, Examples of mechatronics systems, definition of Mechatronics, Multi-disciplinary scenario, origins. Evaluation of Mechatronics, An over view of mechatronics, Design of mechatronics system. Measurements system and function of main elements of measurement systems. Need for mechatronics in industries. Objectives, advantages and disadvantages of mechatronics. Microprocessor based controllers. Principle of working of engine management system, automatic washing machine.

Unit-2

Transducers and Sensors:- Definition and classification of transducers. Definition and classification of sensors. Principle of working and applications of light sensors, proximity sensors and Hall effect sensors. **Microprocessor:-** Microprocessor based digital control. Digital number system, binary and hexadecimal number system, Logic functions, Karnaugh Map, Data word representation basic Elements of control systems.

Unit-3

Microprocessor Architecture:- 8085A processor architecture Terminology-such as, CPU, memory and address, ALU, assembler, data, registers, Fetch cycle, write cycle, state, bus interrupts. Micro controllers - difference between microprocessor and micro controllers. Requirements for control and their implementation in micro controllers. Classification of micro controllers.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Unit-4

Electrical Actuators:- Actuator and actuator system. Classifications of actuator system with examples. Mechanical switches. Concept of bouncing Methods of Preventing bouncing of mechanical switches. Solenoids, Relays. Solid state switches - Diodes, Thyristors, Triacs, Transistors, Darlington pair.

Electrical actuator:- Principle, construction and working of AC, DC motors, stepper motors, permanent motors, servomotors, Servo systems and control

Hydraulic Actuators:- Valves Classifications, Pressure Control Valves , Pressure relief valves, Pressure regulating/reducing valves, Pressure sequence valve. Flow control valves, Principle, needle valve, globe valve. Direction control valve, sliding spool valve, solenoid operated.

Unit-5

Single Conditioning:- Concept, necessity, op-amps, protection, filtering, wheat stone bridge, Digital Signals Multiplexer. Data acquisition, Introduction to signals, and systems to digital signal processing, Concepts and different methods.

Text Book/References Books/ Websites

1. Mechatronics - Principles, Concepts and applications - Nitaigour and Premchand, Mahilik - Tata McGraw Hill -2003
2. Mechatronics - W. Bolton, Longman, Pearson Education Asia -2nd Edition, 2001.
3. Introduction to mechatronics and measurement systems -David G. Alciatore & Michel BiHstand - Tata McGraw Hill -2000
4. Mechatronics - H.D. Ramachandra - Sudha Publication -2003
5. Mechatronics by HMT Ltd. - Tata McGrawHill -2000.
6. Mechatronics System design by Devadas Shetty and Richard A. Kark-Thomas Learning - 1997.
7. Mechatronics an Introduction by Robert H Bishop - CRC
8. Mechatronics systems Fundamentals by Rolf Isermann – Springer
9. Mechatronics: An Integrated Approach by C.W.De Silva, Publisher: CRC;
10. Microprocessor and Architecture, Programming and Applications with 8085/8085A- R.S.Ganokar, Wiley Eastern

Suggested List of Laboratory Practical (Expandable):

1. To perform the 8 - bit addition using 8085 Microprocessor.
2. To sort an array of „n“ element in ascending order using 8085 microprocessor.
3. To run a stepper motor at different speeds and different directions using 8051 assembly language.
4. To measure the speed of DC motor using optical sensor.
5. To study the characteristics between the strains applied to the cantilever beam strain sensor and the bridge voltage.
6. To study the characteristics of LVDT position sensor with respect to the differential voltage.
7. To study the characteristics of temperature measurement system and the accuracy of signal conditioning board



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

8. To construct a pneumatic circuit to actuate the single acting cylinder using a two-way pressure valve.
9. To study the actuation of double acting cylinder using electrical push button switch in meter - in circuit.
10. To study the actuation of the rotary actuator using electrical push button switch in meter - out circuit.
11. To actuate the single acting cylinder with PLC using OFF delay timer.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year-

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	QM & SQC	ME- 5041(B)	4L-0T-2P	6

Unit 1

Evolution of total quality management, historical perspective, teamwork, TQM and ISO 9000; information technology and Business Process Re-engineering (BPR); TPM and quality awards; aids and barriers to quality mgt, creating vision and initiating transformation, establishing programs for education and self coordination, policy setting and review, flowchart of policy mgt and relation with daily mgt. improvements, measurement of key indicators; quality mgt leader; cross functional teams and coordination, policy setting and review, flowchart of policy mgt and relation with daily mgt.

Unit 2

Process- definition, variation and feedback, funnel-marble experiment- rules of adjustment and its effects, quality- definition, goalpost and kaizen view, quality of design, conformance and performance; Taguchi loss function, cost of quality, chain action of improving quality to productivity to motivation and low cost; Deming's theory of mgt, fourteen points and variance reduction; attributes enumerative and variables analytic studies.

Unit 3

SQC-Control charts: basic discrete and continuous distributions, measures of central tendency, variability and shapes, sampling, size and central value theorem, control chart structure, process plotting and stability, study of out-of-control evidences, defect detection and prevention, use of control charts in evaluating past, present and future trends; attribute control charts, count and classification charts, construction and interpretation of p , np , c and u charts,

PDSA cycle(plan, do, study, act), and R charts, and s charts, individual and moving range chart, trial control limits and out of control points.

Unit 4

Process diagnostics: Between and Within Group variations, periodic and persistent disturbances, control chart patterns-natural, level-shift, cycle, wild, multi-universe, relationship and other out of control patterns; diagnosing a process, brainstorming; cause-effect, Ishikawa, interrelationship, systematic and matrix diagrams; change concepts and waste elimination

Unit 5

Process improvement: Performance and technical specifications, attribute-process and variable-process capability studies; unstable and stable process capability studies and examples; attribute and variable improvement studies; Inspection: acceptance sampling(AS)- lot formation, single, double and multiple/sequential sampling plans, operating characteristic (OC) curve, producer and consumer risk, theoretical invalidation of AS, kp rule for stable and chaotic processes.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

References:

1. Gitlow HS, Oppenheim et al; Quality Management; TMH
2. Gryna FM; Juran's Quality Planning and Analysis; TMH
3. Crosby Philips; Quality is still free; New Amer Library
4. Kulkarni VA and Bewoor AK; Quality Control; Wiley
5. Jankiraman B and Gopal RK; Total Quality Management- Text and Cases; PHI Learning
6. Sugandhi L and Samuel A; Total Quality Management; PHI Learning
7. Subburaj R; Total Quality Management; TMH
8. Naidu Babu and Rajendran; TQM; New age International pub;
9. Chase Richard B et al; Operations management; SIE-TMH
10. Chary SN; Production and Operations Management; TMH



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year-

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	Finite Element Method	ME- 5041(C)	4L-0T-2P	6

Unit-I

Introduction Structural analysis, objectives, static, Dynamic and kinematics analyses, Skeletal and continuum structures, Modeling of infinite d.o.f. system into finite d.o.f. system, Basic steps in finite element problem formulation, General applicability of the method.

Unit-II

Element Types and Characteristics Discretization of the domain, Basic element shapes, Aspect ratio, Shape functions, Generalized co-ordinates and nodal shape functions. ID spar and beam elements, 2D rectangular and triangular elements, Axisymmetric elements.

Unit-III

Assembly of Elements and Matrices Concept of element assembly, Global and local co-ordinate systems, Band width and its effects, Banded and skyline assembly, Boundary conditions, Solution of simultaneous equations, Gaussian elimination and Cholesky decomposition methods, Numerical integration, One and 2D applications.

Unit-IV

Higher Order and Isoparametric Elements One dimensional quadratic and cubic elements, Use of natural co-ordinate system, Area co-ordinate system continuity and convergence requirements, 2D rectangular and triangular requirement.

Unit-V

Static & Dynamic Analysis:-Analysis of trusses and frames, Analysis of machine subassemblies, Use commercial software packages, Advantages and limitations Hamilton's principle, Derivation of equilibrium, Consistent and lumped mass matrices, Derivation of mass matrices for 1D elements, Determination of natural frequencies and mode shapes, Use of commercial software packages.

References:

- Rao, S.S., The Finite Element Method in Engineering, 2nd ed., Peragamon Press, Oxford.
- Robert, D. Cook., David, S. Malkins, and Michael E. Plesha, Concepts and Application of Finite Element Analysis 3rd ed., John Wiley.
- Chandrupatla, T.R. and Belegundu, A.D., Introduction to Finite Elements in Engineering, Prentice Hall of India Pvt. Ltd.
- Zienkiewicz O C, The Finite Element Method, 3rd ed, Tata McGraw Hill.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year-
Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	CFD(Computational Fluid Dynamics)	ME- 5041(D)	4L-0T-2P	6

Course Outcomes

- CO1: Understand the classification of PDEs, governing equations
CO2: Understand the basic principles of computational methods
CO3: Apply finite volume method to solve steady and unsteady diffusion, advection-diffusion problems
CO4: Understand Solution algorithms and various discretization schemes.
CO5: Solve engineering problems using CFD software

Unit 1

Introduction to Computational Fluid Dynamics and Principles of Conservation:

Continuity Equation, Navier Stokes Equation, Energy Equation and General Structure of Conservation Equations, Classification of Partial Differential Equations and Physical Behaviour, Approximate Solutions of Differential Equations: Error Minimization Principles.

Unit 2

Fundamentals of Discretization: Finite Element Method, Finite Difference and Finite Volume Method, Consistency, Stability and Convergence. 1-D Steady State Diffusion Problems- Source term linearization, Implementation of boundary conditions

Unit 3

1-D unsteady state diffusion problems: implicit, fully explicit and Crank-Nicholson scheme. Finite volume discretization of convection-diffusion problem. Central difference scheme, Upwind scheme, Exponential scheme and Hybrid scheme, Power law scheme, Generalized convection-diffusion formulation, Finite volume discretization of two-dimensional convection-diffusion problem. The concept of false diffusion, QUICK scheme, TVD schemes and flux limiter functions.

Unit 4

Finite Volume Discretization: Finite Volume Discretization of 2-D unsteady State Diffusion type Problems, Solution of Systems of Linear Algebraic Equations: Elimination Methods, Iterative Methods Discretization of Navier Stokes Equations, primitive variable approach, SIMPLE Algorithm, SIMPLER Algorithm, Unstructured Grid Formulation.

Unit-5

Introduction to Turbulence Modeling: Important features of turbulent flow, General Properties of turbulent quantities, Reynolds average Navier stokes (RANS) equation, Closure problem in turbulence: Necessity of turbulence modeling and applications.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Textbook / Reference

Textbook(s)

- Versteeg, H.K., and Malalasekara, W, “An Introduction to Computational Fluid Dynamics”, The Finite Volume Method, 2007.
- Moukalled, F., Mangani, L., & Darwish, M. “The finite volume method in computational fluid dynamics. An Advanced Introduction with OpenFOAM and Matlab”, 2016.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year-
Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
ME	SWAYAM/NPTEL- MOOC-1	ME.- 5041(E)/Code as per SWAYAM/NPTEL- MOOC	4L-0T-0P	4

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R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

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R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year-
Course Content & Grade

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	INTERNAL COMBUSTION ENGINE	ME - 6011	4L-0T-2P	6

Course Outcomes:- After studying this course, students will be able to,

CO1-To teach students the operating characteristics and thermodynamic analysis of common internal combustion engine cycles

CO2- To teach students to analyze the combustion process of common fuels.

CO3- To make students aware of the roles of fluid flow and heat transfer in engine operation.

CO4-To teach students the environmental, social, and technological issues related to the future widespread use of internal combustion engines

UNIT – I

Internal Combustion Engine:- S.I. and C.I. engines of two and four stroke cycles, determination of engine dimensions, speed, fuel consumption, output, mean effective pressure, efficiency, factors effecting volumetric efficiency, heat balance, cylinder arrangement, firing order, power balance for multi-cylinder engines, valve timing. Thermodynamic properties of fuel-air mixture before and after combustion, deviations of actual cycle from Ideal conditions.

UNIT – II

Combustion in S.I. Engines:- The Process of combustion, Effects of engine variables on ignition lag and flame propagation, abnormal combustion, knocking, effects and control of knock, Knock theory, effects of engine variable on knock, S.I. Engine fuel properties, Knock rating of fuel, octane number, additives, requirements of combustion chamber, Design Principles, Types of combustion chambers, merits.

Combustion in C.I. Engines:- Combustion Process, Stages, diesel knock, effects of operating parameters on knock, knock Control, rating of C.I. engine fuels, Cetane number, types and requirements of the combustion chambers.

Emission and Control:- SI and CI engine emissions, effects of pollutants on human health and biological sphere, Control of emissions from SI and CI Engines, Introduction to Noise Pollution & its Control.

UNIT – III

Engine Operating Systems:- Valves and valve gear, lubrication systems, and system components, lubricating oils, properties and rating, additives. Cooling systems, temperature gradients in engine parts, various methods of cooling, Power absorbed in cooling, Properties of coolants, additives. Fuel systems for SI and CI engines, F/A ratio requirements for different operating conditions, fuel transfer pump, fuel



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

injection pump, injector, Modern carburetors, MPFI in SI engines. Conventional & Modern Ignition system, firing order.

UNIT – IV

Engine Performance:- Testing of Engines - their performance characteristics, Heat Balance sheet, Scavenging processes, Volumetric, charging and scavenging efficiencies, scavenging methods and systems of four stroke and two stroke engines.

UNIT-V

Supercharging:- Supercharging suitability for SI and CI engines and effect of attitude on mixture strength and output of S.I. engines, Types of supercharging, analysis and performance, low and high pressure super charging, exhaust, gas turbo-charging, supercharging of two stroke engines.

Text Book/References Books/ Websites:

1. I.C. Engine by M.L. Mathur, R.P.Sharma; Dhatpat Rai Pub.
2. I.C. Engine by V. Ganeshan ; Tata McGra Hill.
3. I.C. Engines by Anand V. Domkundwar, V.M. Domkundwar; Dhatpat Rai Pub

Suggested List of Laboratory Practical (Expandable):

1. To Study four strokes spark ignition (S.I) Engine and differences between S.I. and C.I engines.
2. To study two Strokes S.I. engine and differences between two strokes and four strokes engines.
3. To study battery ignition system for four cylinders S.I. engines and requirements of ignition system.
4. To study magneto ignition system for SI engine having four cylinders and differences between magneto and battery Ignition system.
5. Study of carburetor with compensating and starting Jet devices.
6. Determination of Brake power (BP), friction power (FP) and Indicated power (IP) of four stroke four cylinder diesel engine with rope break dynamometer.
7. To determine Mechanical efficiency, Brake thermal efficiency and indicated thermal efficiency of four strokes, four cylinder diesel engine.
8. To draw heat balance sheet for four stroke, four cylinder diesel engines.
9. To study open cycle constant pressure combustion gas turbine with inter cooler, regenerator and reheater
10. To study centrifugal compressor and differences between centrifugal and axial compressors.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

THIRD YEAR-
Semester–VI Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	MACHINE COMPONENT DESIGN	ME - 6021	3L-1T-2P	6

Course Outcomes: After studying this course, students will be able to, CO1- Helping

the student in machine design their technical ideas

CO2- Creating knowledge about the various practices with regard to the shaft, bearing and development of views

CO3- Understanding the importance of the linking functional and visualization aspects in the preparation of the part object

CO4- Interpretation of machine Component that in turn help the students in the preparation of the production of machine Component.

UNIT – I

Introduction:- Basic design concepts, design process, stages/phases in design, flowchart, problem formulation, design considerations (strength, manufacturing, maintenance, environment, economics and safety); design for recycle and reuse, Design and safety factors for steady and variable loads, impact and fatigue considerations, reliability and optimization, standardization in design.

UNIT – II

Power Transmissions Systems, Pulleys:- Transmission of power by Belt and Rope drives, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives, Materials, Chain drives.

Spur & Helical& Bevel Gear Drives :- Spur gears- Helical gears – Load concentration factor

– Dynamic load factor. Surface compressive strength – Bending strength – Design analysis of spur gears – Estimation of centre distance, module and face width, check for plastic deformation. Check for dynamic and wear considerations. Design bevel gear and its application.

UNIT – III

Springs:- Design of helical compression and tension springs, leaf springs and torsion springs; fatigue loading of springs, surge in spring.

Shafts:- Design of shaft under combined bending, twisting and axial loading; shock and



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

fatigue factors, design for rigidity; Design of shaft subjected to dynamic load; Design of keys and shaft couplings.

UNIT – IV

Bearings :- Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design – Ball and roller bearings – Static loading of ball & roller bearings, Bearing life.

Design of power screws:- Design of screw, Square ACME, Buttress screws, design of nut, compound screw, differential screw, ball screw- possible failures.

UNIT – V

Brakes & Clutches:- Materials for friction surface, uniform pressure and uniform wear theories, Design of friction clutches: Disk , plate clutches, cone & centrifugal clutches. Design of brakes: Rope, band & block brake, Internal expanding brakes, Disk brakes

Engine Parts : Connecting Rod : Thrust in connecting rod – stress due to whipping action on connecting rod ends – Cranks and Crank shafts, strength and proportions of over hung and center cranks – Crank pins, Crank shafts.

Text Book/References Books/ Websites:

1. Shingley J.E; Machine Design; TMH
2. Machine Design by R. S. Khurmi , S Chand
3. Sharma & Agrawal; Machine Design; Kataria & sons
4. Machine Design, V.Bandari Tmh Publishers
5. Machine Design, S MD Jalaludin, Anuradha Publishers
6. Sharma and Purohit; Design of Machine elements; PHI
7. Data Books : (I) P.S.G. College of Technology (ii) Mahadevan

Suggested List of Laboratory Practical (Expandable):

1. To design of the different types of Break.
2. To design of the different types of clutch.
3. To design of connecting rod.
4. To design of center crankshaft.
5. To design of crane hook.
6. To Study of Different Types of Power Transmission System.
7. To Study of Different types of shaft
8. To Study of Different types of spring.
9. To Study of Different types of Bearing



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

THIRD YEAR-
Semester–VI Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	GAS DYNAMICS	ME – 6031(A)	4L-0T-2P	6

Course Outcomes: After studying this course, students will be able to,

CO1- Explain basic concepts of gas dynamics and describe the basic fundamental equations of one dimensional flow of compressible fluid and isentropic flow of an ideal gas.

CO2- Analyze the steady one-dimensional is entropic flow; frictional flow and isothermal flow and express the concepts of steady one dimensional flow with heat transfer

CO3- Discuss the effect of heat transfer on flow parameters. CO4- Describe the jet propulsion engines

UNIT - I

Introduction to gas dynamics:- control volume and system approaches acoustic waves and sonic velocity - Mach number - classification of fluid flow based on mach number - mach cone- compressibility factor - General features of one dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.

UNIT - II

Isentropic flow of an ideal gas:- basic equation - stagnation enthalpy, temperature, pressure and density- stagnation, acoustic speed - critical speed of sound dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area - stream thrust and impulse function. Steady one dimensional isentropic flow with area change-effect of area change on flow parameters chocking- convergent nozzle.

UNIT - III

Simple frictional flow:- adiabatic flow with friction in a constant area duct governing equations fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct governing equations - limiting conditions. Steady one dimensional flow with heat transfer in constant area ducts- governing equations - Rayleigh line entropy change caused by heat transfer- conditions of maximum enthalpy and entropy.

UNIT - IV

Effect of heat transfer on flow parameters:- Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas- properties of flow across a normal shock - governing equations - Rankine Hugoniat equations Prandtl's velocity relationship - converging diverging nozzle flow with shock thickness – shock strength.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

UNIT-V

Steam nozzles:- isentropic flow of vapors, flow of steam through nozzles, condition for maximum discharge, effect of friction, super-saturated flow.

Text Book/References Books/ Websites:

1. P. K. Nag Power plant engineering Tata McGraw Hill.
2. Fredrick T. Mosse Power plant engineering East-West press.
3. A. Chkrabarti and M. L. Soni A text book of Power System Engineering Dhanpat Rai and Co.
4. Arora and Domkundwar A course in power plant engineering Dhanpat Rai and Co.
5. Thomas C. Elliott, Standard handbook of power plant engineering 1997 Tata McGraw Hill.

Suggested List of Laboratory Practical (Expandable):

1. Study of Jet impact on flat and curved surfaces.
2. Study of Measurement of drag on a circular cylinder in high Reynolds number flow.
3. Study of Energy loss measurements in subcritical and supercritical open channel flow.
4. Study of Measurement of fluid viscosity. Determination of friction factor as a function of Reynolds number in pipe flow.
5. Study of Studying laminar-turbulent transition for flow in a tube vii. Boundary layer flow over a flat plate.
6. Study of Pressure distribution around a circular cylinder in high Reynolds number flow.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

THIRD YEAR-
Semester–VI Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	Solar Thermal Engineering	ME – 6031(B)	4L-0T-2P	6

Course Contents

Unit-1

Solar Radiation: Solar Radiation, instruments for measuring solar radiation, solar radiation geometry, empirical equations, solar radiation on tilted surfaces. Liquid Flat Plate Collectors: Basic elements, performance analysis, transmissivity - absorptivity, heat transfer coefficients and correlations, collector efficiency and heat removal factors, effects of various parameters, types of other liquid flatplate collectors, transient analysis.

Unit-2

Solar Air Heaters: Type of air heaters, performance analysis of a conventional air heater, other types of air heater, and testing procedures. Concentrating Collectors: Type of concentrating collectors and their general characteristics, geometry, heat transfer correlations, tracking requirements performance analysis.

Unit-3

Thermal Energy Storage: Basic methods, Sensible heat storage –liquids- solids-analysis, latent heat storage, thermo chemical storage. Solar Pond: Basic concept and working, description, performance analysis, transmissivity, temperature distribution and collection efficiency, experimental studies and other aspects.

Unit-4

Solar Refrigeration: Adsorption and absorption based solar refrigeration technologies.

Unit-5

Different Types of solar thermal plants in India and Globe Standard of Solar Thermal plants

Text book -

1. Garg H.P. and Prakash J., Solar energy fundamentals and application, TATA McGraw Hill Publishing Company limited, New Delhi, 2000.
2. Sukhatme S.P., Solar Energy Principle of thermal collection and storage, TATA McGraw Hill Publishing Company limited, New Delhi, 1996.
3. Krith F. and Krelder J.F., Principles of Solar Engineering, McGraw hill Book Company, 1978.
4. John A, Duffie, William A. Beckman; Solar Engineering of thermal processes, John Wiley and Sons, 1991.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

THIRD YEAR- Semester–VI Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	Rapid Prototyping	ME – 6031(C)	4L-0T-2P	6

Course Outcomes: At the end of the course, the student will be able to

CO1: explain the fundamental concepts, historical development and applications of Rapid Prototyping systems

CO2: discuss the operating principles, capabilities and advantages of Solid based RP systems

CO3: describe conceptual design and product development of powder based RP systems

CO4: use suitable software in evaluation of STL file problems

CO5: explain typical applications of RP technologies in traditional and value-added industries

UNIT- I Introduction to Rapid Prototyping:

Introduction, Prototype fundamentals, Historical development, Fundamentals of Rapid Prototyping, Process Chain, Classification of RP systems, applications and benefits of Rapid Prototyping. Liquid-Based Rapid Prototyping Systems: Stereo Lithography Apparatus (SLA), Models and specifications, working principle, process, Photopolymers, Photo polymerization, layering technology,

Laser and Laser scanning, advantages and disadvantages, applications. Micro Stereo lithography. Rapid Freeze Prototyping (RFP) Process: Principle and process description, major hardware used in the system, Potential applications. Solid Ground Curing (SGC) Process: Models and specifications, working principle, process, materials used for creating parts, applications, advantages and disadvantages.

UNIT- II Solid-Based Rapid Prototyping Systems:

Fusion Deposition Modeling (FDM): Models and specifications, working principle, process, applications, advantages and disadvantages. Laminated Object Manufacturing (LOM): Models and specifications, Principle, process, materials used, advantages and disadvantages, applications.

Multi-Jet Modeling(MJM): Working principle, process, applications, advantages and disadvantages. Plastic Sheet Lamination(PSL)Process: Working principle, process, advantages and disadvantages, applications. Shape Deposition Manufacturing(SDM) process: Principle, process, part materials and support materials, advantages and disadvantages, applications.

UNIT- III Powder-Based Rapid Prototyping Systems:

Selective Laser Sintering (SLS)Process: Models and specifications, working principle, process, materials used, applications, advantages and disadvantages. Laser Engineered Net Shaping (LENS) process: Models and specifications, working principle, process, applications, advantages and disadvantages.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Three Dimensional Printing (3DP) process; Models and specifications, working principle, process, applications, advantages and disadvantages. Mask less Mesoscale Material Deposition(M3D) process: Concept, process description, applications, advantages. Electronic Beam Melting (EBM) process: Principle, process, hardware components, applications, advantages and disadvantages. Multiphase Jet Solidification (MJS) process: Principle, data preparation, model building, influence of process parameters, advantages and disadvantages, applications.

UNIT- IV Rapid Prototyping Data Formats and Software:

STL format, STL file problems, consequences of building valid and invalid tessellated models, STL file repairs: Generic solution, other translators, newly proposed formats. Features of RP software like MAGICS, MIMICS, Solid view, Velocity2, Rhino, View expert,3D Doctor.

UNIT- V Rapid Tooling and RP Applications

Rapid Tooling: Introduction, Conventional tooling Vs Rapid tooling, need for Rapid tooling. Rapid tooling classification: Indirect Rapid tooling methods: Spray metal deposition, RTV Epoxy tools, Ceramic tools, Investment casting, Spin casting, Die casting, Sand casting,3D Keltool process. Direct Rapid tooling methods: Direct AIM, LOM tools, DTM Rapid tool process, EOS direct tool process, direct metal tooling using 3DP.

RP applications: Material relationship, application in design, application in Engineering, Analysis and Planning, Aerospace industry, Automotive industry, Jewelry industry, Coin industry, Tableware industry, GIS applications, Arts and Architecture applications, Medical and Bioengineering applications.

Text Book:

Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 3rd Edition, World scientific publications, 2014.

Reference Books:

1. Pham,D.T. and Dimov.S.S., Rapid manufacturing, Springer, London, 2001.
2. Fuewen Frank Liou, Rapid prototyping and Engineering Applications, CRC Press, 2019.
3. Ian Gibson,David W Rosen,Brent Stucker “ Additive manufacturing technologies : 3D printing, Rapid Prototyping and Direct Digital manufacturing” 2nd edition,Springer,2015.
4. Ali.k. Kamrani,E.A.Nasr “ Rapid Prototyping: Theory and practice”,Springer,2006



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

THIRD YEAR-

Semester–VI

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	Electric and Hybrid Vehicles-II	ME – 6031(C)	4L-0T-2P	6

Unit-1 - Energy Storage Solutions(ESS)

Cell Types (Lead Acid/Li/NiMH), Battery charging and discharging calculation, Cell Selection and sizing, Battery layouting design, Battery Pack Configuration, Battery Pack Construction, Battery selection criteria

Unit 2 -Battery Management System(BMS)/Energy Management System (EMS)

Need of BMS, Rule based control and optimization based control, Software-based high level supervisory control, Mode of power, Behavior of motor, Advance Features

Unit 3 - Control Unit

Function of CU, Development Process, Software, Hardware, Data Management, GUI/HMI

Unit 4:-. Electric Vehicles charging station

Type of Charging station, Selection and Sizing of charging station, Components of charging station, Single line diagram of charging station

Unit 5:- Software

Software used in design and maintenance, Tool used in simulation and modeling of EV, Solar EV Vehicle

Suggested Books:

1. Ehsani, Mehrdad, et al. Modern electric, hybrid electric, and fuel cell vehicles. CRC press 2018
2. Genta, G., and L. Morello. "The Automotive Chassis, Volume 1: Components Design, Springer Nature, 2009
3. Jazar, Reza N. Vehicle dynamics: theory and application. Springer 2017
4. Rajesh Rajamani, Vehicle Dynamics and Control, Springer 2012
5. Husain, Iqbal. Electric and hybrid vehicles: design fundamentals. CRC press 2010

List of Experiments: -

1. Familiarization of Electric Vehicle Control Modules
2. Modelling Studies of Electric Vehicles
3. Model Identification techniques for Electric Vehicle
4. Tuning Techniques for PI/PID Controller
5. PI/PID controller for Electric Vehicle
6. IMC based control techniques
7. Model based control techniques for Electric Vehicle
8. Modelling, Control in State space for Electric Vehicle
9. Study of Observer design for Electric Vehicle



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Semester–V Third Year- Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
ME	SWAYAM/NPTEL- MOOC-1	ME. -6031(D)/Code as per SWAYAM/NPTEL-MOOC	4L-0T-0P	4

Guideline

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In perspective of the need to create synergist between the salient features of 'anytime anywhere' format of e-learning and traditional classrooms chalk and talk method to develop a unique content delivery mechanism which is responsive to learners' needs and ensuring seamless transfer of knowledge across geographical boundaries. RKDF University proposes to incorporate MOOC courses delivered by SWAYAM/NPTEL portal. Student can opt any courses from SWAYAM/NPTEL-MOOC courses as an elective Base on following condition

1. He/She has consulted and inform to the departmental coordinator regarding courses selection and mark obtain to him. No Subjected should be repeat from courses which is offer and courses which are selected.
2. He/She can opt from only courses which are not available from University.
3. Only enrolment in the courses and learning from it is free as this is a project supported by MHRD GOI.
4. To get Certificate from SWAYAM-NPTEL. The learner has to separately register and appear for a proctored exam at a fee as decided by host institution/Mooc of Rs. 1000/- Which be bearded by Student only.
5. If student successful appear in exam and obtain certificated of courses of 12 week course to earn 3 credits(As recommended by NPTEL) to suffice for required credit for the award of his/her degree.
6. The NPTEL recommended that an additional 1 credit may be awarded given by University. This credited can be given based on attendances, assignment and tutorial work submitted by the students.
7. All students would be motivated to take courses online with SWAYAM/NPTEL every semester to better prepared for the future so that they can cultivate the habit of self-study online. The University propose to implement MOOC courses under Department. The University also made provision if student unable to get certificate He/She still be able to appear in the department elective courses and complete there degree



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

THIRD YEAR-
Semester–VI Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	MECHANICAL MEASUREMENT & CONTROL	ME – 6041(A)	4L-0T-2P	6

Course Outcomes. After studying this course, students will be able to CO1-Inspection of engineering parts with various precision instruments.

CO2- Principles of measuring instruments and gauges and their uses.

CO3- Understand the importance of material properties in designing the mechanical systems and identify the material for specific applications

CO4- Understand the changes in phases of material with respect to time and temperature

UNIT-I

Mechanical Measurements Introduction:- Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors. 4 Sensors and Transducers: Types of sensors, types of transducers and their characteristics 2 Signal transmission and processing: Devices and systems. 2 Signal Display & Recording Devices.

UNIT-II

Statistics:- Least square regression analysis and data outlier detection; Normal distribution and concept of standard deviation of the mean in finite data set, Uncertainty Analysis: Measurement errors; error sources: calibration, data acquisition, data reduction; Design stage uncertainty analysis; combining elemental errors; Bias & Precision errors; Error propagation, Higher order uncertainty analysis.

UNIT-III

Metrology:- Metrology and Inspection: Standards of linear measurement, line and end standards .Limit fits and tolerances. Interchange ability and standardization. Linear and angular measurements devices and systems Comparators: Sigma, Johansson's Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design.

UNIT-IV

Measurement of geometric forms:- straightness, flatness, roundness. Tool maker's microscope, profile project autocollimator. Interferometer: principle and use of interferometer, optical flat. Measurement of screw threads and gears.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Surface texture :- quantitative evaluation of surface roughness and its measurement.

UNIT-V

Introduction:- Concept of Automatic Controls – open loop & closed loop systems. Servo mechanisms. Block diagrams, transfer functions. Applications of Laplace-Transform in control systems with simple examples / numerical. Controllers: Brief introduction to Pneumatic, hydraulic and electric controllers Modeling: Modeling of mechanical systems, modeling of electrical systems, signal flow graphs, modeling of fluid systems, liquid level systems, hydraulic systems, modeling of thermal systems.

Text Book/References Books/ Websites:

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., “Measurement Systems, Application Design”, McGraw Hill, 1990.
3. Kumar D.S., “Mechanical Measurements and Control”, Metropolitan, N. Delhi.
4. Hume K.J., “Engineering Metrology”, MacDonald and Co. 1963
5. Gupta, I.C., “Engineering Metrology”, Dhanpat Rai & Sons, New Delhi, 1994
6. Sirohi, “Mechanical Measurement” New Age Publishers
7. Jain, R.K., “Engineering Metrology” Khanna Publishers
8. Jain, R.K., “Mechanical Measurement” Khanna Publishers
9. Raven, “Automatic Control Theory”, McGraw Hill Publishers.
10. Nagrath and Gopal, “Control System Engineering”, New Age Publishers.

Suggested List of Laboratory Practical (Expandable):

1. To study of different types of transducers
 - (a) Pressure transducers.
 - (b) Temperature Transducers. © LVDT.
2. To study of open loop and closed loop system.
3. To study different types of surface roughness textures.
4. To study of different types of comparators.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

THIRD YEAR-
Semester–VI Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	Optimization Techniques	ME – 6041(B)	4L-0T-2P	6

Unit 1 Introduction to Optimization:

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

Unit 2 Linear programming methods for optimum design:

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

Unit 3 Optimization algorithms for solving unconstrained optimization problems:

Gradient based method: Cauchy's steepest descent method, Newton's method, Conjugate gradient method.

Unit-4 Optimization algorithms for solving constrained optimization problems:

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

Unit 5 Modern methods of Optimization:

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

References:

1. Rao S. S. - 'Engineering Optimization, Theory and Practice' - New Age International Publishers - 2012 -4th Edition.
2. Deb K. - 'Optimization for Engineering Design Algorithms and Examples' – PHI - 2000
3. Arora J. - 'Introduction to Optimization Design' - Elsevier Academic Press, New Delhi - 2004
4. Saravanan R. - 'Manufacturing Optimization through Intelligent Techniques' - Taylor & Francis (CRC Press) -2006
5. Hardley G. -'Linear Programming' - Narosa Book Distributors Private Ltd. – 2002



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

THIRD YEAR- Semester–VI Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	Renewable Energy Technology	ME – 6041(C)	4L-0T-2P	6

UNIT-I Solar Radiation:

Extra-terrestrial and terrestrial, radiation measuring instrument, radiation measurement and predictions. Solar thermal conversion: Basics, Flat plate collectors-liquid and air type. Theory of flat plate collectors, selective coating, advanced collectors, Concentrators: optical design of concentrators, solar water heater, solar dryers, solar stills, solar cooling and refrigeration. Solar photovoltaic: Principle of photovoltaic conversion of solar energy; Technology for fabrication of photovoltaic devices; Applications of solar cells in PV generation systems; Organic PV cells.

UNIT-II Wind Energy:

Characteristics and measurement: Metrology of wind speed distribution, wind speed statistics, Weibull, Rayleigh and Normal distribution, Measurement of wind data, Energy estimation of wind regimes; Wind Energy Conversion: Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics; power curve of wind turbine, capacity factor, matching wind turbine with wind regimes; Application of wind energy.

UNIT-III Production of biomass:

Photosynthesis-C3 & C4 plants on biomass production; Biomass resources assessment; Co₂ fixation potential of biomass; Classification of biomass; Physicochemical characteristics of biomass as fuel Biomass conversion routes: biochemical, chemical and thermo chemical Biochemical conversion of biomass to energy: anaerobic digestion, biogas production mechanism, technology, types of digesters, design of biogas plants, installation, operation and maintenance of biogas plants, biogas plant manure-utilization and manure values. Biomass Gasification: Different types, power generation from gasification, cost benefit analysis of power generation by gasification.

UNIT-IV Small Hydropower Systems:

Overview of micro, mini and small hydro system; hydrology; Elements of turbine; Assessment of hydro power; selection and design criteria of turbines; site selection and civil works; speed and voltage regulation; Investment issue load management and tariff collection; Distribution and marketing issues. Ocean Energy: Ocean energy resources, ocean energy routs; Principle of ocean thermal energy conversion system, ocean thermal power plants. Principles of ocean wave energy and Tidal energy conversion.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

UNIT-V Geothermal Energy:

Origin of geothermal resources, type of geothermal energy deposits, site selection geothermal power plants; Hydrogen Energy: Hydrogen as a source of energy, Hydrogen production and storage. Fuel Cells: Types of fuel cell, fuel cell system and sub-system, Principle of working, basic thermodynamics

References:

1. Kothari, Singal & Rajan; Renewable Energy Sources and Emerging Technologies, PHILearn
2. Khan, B H, Non Conventional Energy, TMH.
3. Sukhatme and Nayak, Solar Energy, Principles of Thermal Collection and Storage, TMH.
4. Tiwari and Ghosal, Renewable Energy Resources: basic principle & application, NarosaPubl
5. Koteswara Rao, Energy Resources, Conventional & Non-Conventional, BSP Publication.
6. Chetan Singh Solanki, Solar Photovoltaics: Fundamental, technologies and Application, PHI L
7. Abbasi Tanseem and Abbasi SA; Renewable Energy Sources; PHI Learning
8. Ravindranath NH and Hall DO, Biomass, Energy and Environment, Oxford University Press.
9. Duffie and Beckman, Solar Engineering of Thermal Process, Wiley
10. Nikolai, Khartchenko; Green Power; Tech Book International
11. Tester, Sustainable Energy-Choosing Among Options, PHI Learning.
12. Godfrey Boyle, Renewable Energy: Power for a sustainable future, Oxford OUP.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

THIRD YEAR-
Semester–VI Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	Additive Manufacturing (3D Printing)	ME – 6041(D)	4L-0T-2P	6

CO COURSE OUTCOMES PO

Upon completion of this course, Students should be able to

1. Understand the construction of basic 3D Printing machines
2. Understand the Energy delivery, Material delivery, Nozzle and Heating Systems
3. Know the Optical & Optoelectronic components in 3D Printing
4. Know the environmental control systems
5. Understand the Pre-processing & Post processing techniques in 3D printing

UNIT–I INTRODUCTION TO 3D PRINTING MACHINES & PROCESSES

Introduction to 3D Printing Machines: Historical Perspectives, Rapid Prototyping - An Integral Part of Time Compression Engineering, RP Information Workflow.

Rapid Prototyping Processes: Classification of Rapid Prototyping Processes, Processes Involving a Liquid - Solidification of a Liquid Polymer, Solidification of an Electroset Fluid: Electrosetting (ES), Solidification of Molten Material, Processes Involving Discrete Particles, Processes Involving Solid Sheets.

UNIT - II RAPID PROTOTYPING SYSTEMS

Stereolithography Apparatus, Solid Ground Curing Systems, Fused Deposition Modelling Systems, Selective Laser Sintering Systems, Laminated Object Manufacturing Systems, Paper Lamination Technology Laser Engineering Net Shaping Systems.

UNIT–III TECHNICAL, TECHNOLOGICAL CAPABILITIES & APPLICATIONS OF RAPID PROTOTYPING TECHNOLOGY:-

Technical Characteristics and Technological Capabilities of Concept: Modellers, 3D Systems Thermo Jet™ Printer, Sanders Model Maker II, Z-Corporation Z402 3D Printer, Stratasys Genisys Xs 3D Printer, JP System, Object Quadra System

Applications of Rapid Prototyping Technology: Functional Models, Pattern for Investment and Vacuum Casting, Medical Models, Art Models, Engineering Analysis Models.

UNIT–IV INDIRECT & DIRECT METHODS FOR RAPID TOOL PRODUCTION

Indirect Methods for Rapid Tool Production: Role of Indirect Methods in Tool Production, Metal Deposition Tools, RTV Tools, Epoxy Tools, Ceramic Tools, Cast Metal Tools, Investment Casting, Fusible Metallic Core, Sand Casting, Keltool Process.

Direct Methods for Rapid Tool Production: Classification of Direct Rapid Tool Methods, Direct ACESTM Injection Moulds, Laminated Object Manufactured Tools, DTM



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

RapidToo1 Process, Sand Form EOS Direct Tool Process, Direct Metal Tooling using 3Dp, Topographic Shape Formation.

UNIT-V APPLICATIONS OF RAPID TOOLING TECHNOLOGY & PROCESS OPTIMISATION

Insert Design, Insert Finishing, Rapid Tooling Inserts Wear Resistance, Case Studies. RPT Optimisation - Factors Influencing Accuracy - Data Preparation, Errors due to Tessellation, Errors due to Slicing, Part Building, Part Building Errors in the SL Process, Part Building Errors in the SLS Process, Part Finishing, Selection of Part Build Orientation, Orientation Constraints of the SL Process, Orientation Constraints of the SLS Process.

TEXT BOOK

1. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer Science & Business Media, 2012.

REFERENCES

1. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: Fourth Edition of Rapid Prototyping
2. Andreas Gebhardt, Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing, Hanser Publications, 2012
3. Peter Hilton & Paul Jacobs, Rapid Tooling: Technologies and Industrial Applications, CRC Press, 2000



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
ME	SWAYAM/NPTEL-MOOC-1	ME. -6041(E)/Code as per SWAYAM/NPTEL-MOOC	4L-0T-0P	4

Guideline

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R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

7. If student successful appear in exam and obtain certificated of courses of 12 week course to earn 3 credits(As recommended by NPTEL) to suffice for required credit for the award of his/her degree.
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R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

THIRD YEAR-

Semester–VI Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	CAD	ME – 6051	0L-0T-2P	2

The purpose of this laboratory is to provide the complete practical exposure of Computer aided design software tools such as Solid works, CATIA, Unigraphics etc., Computer assisted manufacturing processes such as CNC Turning, CNC Milling, CNC Drilling etc as well Computer integrated manufacturing (i.e. demonstrating remotely over the internet the operations of actual CIM cell established in the dept of Institute /industry) to the students so that they will become industry ready just after completing their graduation.

Suggested list Experiments; (Pl expand it)

1. 2D and 3D modeling on CAD software
2. Use of CAM software for writing CNC programs
3. Study of automatic and semi-automatic control system and writing the electrical analogy.
4. Production & layout for GT for group of jobs to be manufactured
5. A case study / tutorial using CAPP Software
6. Writing M & G codes for given operations.
7. Robot and AGV programming
8. Modelling and simulation of computer integrated manufacturing system'
9. Modelling, offline manual part programming and simulation of the operation of 3 axis CNC milling machine
10. Programming and operation of a 5 axis robot Manipulator
11. Remote monitoring and operation of Computer integrated manufacturing system
12. To write the part program for any component (stepped cylindrical rod) . Assuming the work piece is Aluminum and the speed is 1200 rpm, feed 20 mm/min and maximum depth of cut is 1 mm.
 - a. With Canned cycle
 - b. Without Canned cycle.

Evaluation:

Evaluation will be continuous and integral part of the class as well as through external assessment (Viva/voce)



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

THIRD YEAR-
Semester–VI Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	ADVANCE WORKSHOP PRACTISE	ME - 6061	0L-0T-2P	2

Course Outcomes:- After studying this course, students will be able to CO1-Student will be able to make various joints in the given object with the available work material CO2-Student will be able to know how much time a joint will take for the assessment of time

UNIT - I

Lathe: Classification of machine tools and their basic components; lathe-specification, components & accessories, various operations on lathes, capstan & turret lathes, tool layout, methods of thread production, machining time, single point cutting tools, tool signature and nomenclature

UNIT - II

Grinding:- Types of grinding machines, surface, cylindrical and internal grinding, grinding wheels, specifications, wheel turning and dressing without eccentricity, centre-less grinding.

UNIT - III

Milling:- Vertical, horizontal and universal type machines, specifications and classifications of milling machines, universal dividing head plain and different indexing, gear cutting, milling cutters.

Drilling & Broaching:- Fixed spindle, radial and universal drilling machines, drilling time, broaching principle, broaches and broaching machines.

UNIT - IV

Shapers:- Classification and specifications, principle parts, quick return mechanism, shaper operations, speed feed, depth of cut, machining time. Surface qualities, equipment used for rating surfaces, rms. CLA value, causes for surface irregularities.

Gear Cutting:- Die casting, methods of forming gears, generating process, Gear shaping, gear shaving, gear grinding gear testing.

UNIT - V

Control System:- Introduction to control systems, analog control, transfer function, procedure for writing transfer function, signal flow diagram, introduction to electronic components like switches, magnetic type, electromagnetic type, transducers and other sensors, servo motors, basics of CD-ROM players, PLC, applications, CNC machines.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Text Book/References Books/ Websites:

1. Rao PN; Manufacturing Technology vol I and II; TMH
2. Hazra Chadhary; Workshop Tech.II; Media Promoter and Pub
3. Lindberg RA; Processes and Materials of Manufacturing; PHI.
4. Raghuvanshi;BS; Work shop technology Vol-I, II; Dhanpat Rai Delhi
5. Alciatori DG, Histan MB; Introduction to Mechatronics and Measurement system; TMH HMT; Production Processes; TMH

Suggested List of Laboratory Practical (Expandable):

1. To make a job on lathe machine with all operations like turning, step turning, drilling, taper turning, thread cutting and knurling.
2. Study of center less grinding machine/ tool and cutter type grinding machine.
3. Study of horizontal/ universal milling machine, dividing head and indexing mechanism of it.
4. To cut a spur gear on milling machine using rapid indexing method.
5. Study of radial drilling machine and preparing a job on it.
6. To study a tapping machine to learn about working of quick return mechanism.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

THIRD YEAR-
Semester–VI Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	MINOR PROJECT I	ME -6081	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to,

CO1- Enable the Students to undertake short research projects in a team under the direction of members of the faculty

CO2-To impart skills in preparing detailed report describing the project and results.

CO3- To enable the students to undertake fabrication work of new experimental set up/devices or develop software packages

CO4-To effectively communicate by making an oral presentation before an evaluation committee

Contents (Theory)

Students shall be encouraged to form groups (Maximum 5) to do a Minor Project on technical topic of concern branch. The student should prepare a working system or some design or understanding of a complex system (on minor level) that he has selected for his/her minor project work using system analysis tools and submit the same in the form of a write-up i.e. detail project report. The student should maintain proper documentation of different stages of project such as concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan wherever applicable. Each student is required to prepare a project report based on the above points and present the same at the final examination with a demonstration of their project.

Text Book/References Books/ Websites: Nil

Suggested List of Laboratory Experiments :- (Expandable): Nil



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-
Semester–VII Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	HEAT AND MASS TRANSFER	ME - 7011	3L-1T-2P	6

Course Outcomes: After studying this course, students will be able to,
CO1-Students will be able to comprehend the different mode of heat transfer

CO2-Students are expected to formulate basic equations and Laws for heat transfer Problems

CO3- To understand the knowledge of mass transfer by applying principles of diffusion, mass transfer coefficients and inter phase mass transfer.

CO4-Applications of heat transfer principles to design and calculate performance of thermal systems related to one dimensional, steady state and transient state for conduction and convection heat transfer

UNIT-I

Introduction to Heat Transfer:- Concepts of the mechanisms of heat flows; 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. Steady State one-dimensional Heat conduction : Composite Systems in rectangular, cylindrical and spherical ordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation.

UNIT-II

Fins:- Heat transfer from extended surfaces, Fins of uniform cross-sectional area Errors of measurement of temperature in thermometer wells. Transient Conduction: Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts

UNIT-III

Forced Convection:- Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer. Natural Convection : Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere ; Combined free and forced convection.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

UNIT-IV

Thermal Radiation:- Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchhoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect.

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. Condensation And Boiling : Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Drop wise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling. Introduction To Mass Transfer: Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion through a stagnant gas film.

Text Book/References Books/ Websites:

1. Elements of Heat transfer by Bayazitouglu&Ozisik, McGraw-Hill Book Company.
2. Heat Transfer By J.P. Holman, McGraw-Hill International edition.
3. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
5. Fundamentals of Momentum, Heat and Mass Transfer by James R. Welty; John Wiley & Sons (Pvt). Ltd.
6. Heat Transfer, by Vijay Gupta, New Age International (P) Ltd. Publishers
7. Heat Transfer, by Y.V.C. Rao, University Press.
8. Heat Transfer, by R. Yadav, Central Publishing House, Allahabad

Suggested List of Laboratory Practical (Expandable):

1. Study of Conduction through composite wall.
2. Study of Thermal conductivity of slab.
3. Study of Pin fin in natural/forced convection.
4. Study of Parallel and Counter flow in a double pipe heat exchanger.
5. Study of Free/Natural convection.
6. Study of Two phase heat transfer.
7. Study of Emissivity measurement.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-
Semester–VII Course Content & Grade

Branch	Subject Title (Departmental Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	AUTOMOBILE ENGINEERING	ME – 7021 (A)	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1- Identify the different parts of the automobile

CO2-Explain the working of various parts like engine,

transmission, clutch, brakes CO3-Understand the

environmental implications of automobile emissions

CO4- Develop a strong base for understanding future developments in the automobile industry

UNIT - I

Vehicle Structure and Engines: - Types of automobiles, vehicle construction and different layouts, chassis, frame and body, resistances to vehicle motion and need for a gearbox, components of engine- their forms, functions and materials

UNIT - II

Engine Auxiliary Systems:- Electronically controlled gasoline injection system for SI engines., Electronically controlled diesel injection system, Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system, Turbo chargers, Engine emission control by three way catalytic converter system.

UNIT - III

Transmission Systems:- Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, over drive, transfer box, fluid flywheel –torque converter, propeller shaft, slip joints, universal joints, Differential, and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT - IV

Steering, Brakes And Suspension Systems:- Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System and Traction Control

UNIT-V

Electrical And Control Systems:- Storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, Lighting system, head light dazzling, signaling devices, battery operated vehicles, choppers. Importance of maintenance, scheduled and unscheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

control system for automobile, intelligent automobile control systems.

Text Book/References Books/ Websites:

1. Crouse; Automotive Mechanics; TMH.
2. S Srinivasan; Automotive engines; TMH.
3. HN Gupta; Internal Combustion Engines; PHI.
4. Kripal Singh; Automotive Engineering Khanna Publication.
5. Emission standards from BIS and Euro –I and Euro-III



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

THIRD YEAR-
Semester–VII Course Content & Grade

Branch	Subject Title (Departmental Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	MECHANICAL SYSTEM DESIGN	ME – 7021(B)	3L-1T-0P	4

Note: PSG Design data book and/ or Mahadevan and Reddy's Mechanical design data book are to be provided/ permitted in exam hall (duly verified by authority)

Course Outcomes: After studying this course, students will be able to,
CO1-Applied different types power transmission drive in practical use.

CO2-Understand different types of slip less drive like gears in different machinery.

CO3-Undertake different types of internal combustion engines in vehicles and different drives. CO4-Undertake project work different types of optimization techniques.

Unit I

Design of Belt, Rope and Chain Drives:-Methods of power transmission, selection and design of flat belt and pulley; Selection of V-belts and sheave design; Design of chain drives, roller chain and its selection; Rope drives, design of rope drives, hoist ropes.

Unit II

Spur and Helical Gears:-Force analysis of gear tooth, modes of failure, beam strength, Lewis equation, form factor, formative gear and virtual number of teeth; Gear materials; Surface strength and wear of teeth; strength against wear; Design of straight tooth spur and Helical Gears.

Bevel Gears: Application of bevel, formative gear and virtual number of teeth; Force analysis; Lewis equation for bevel gears; Strength against wear; Design of bevel gear.

Unit III

Design of I.C. Engine Components:-General design considerations in I C engines; design of cylinder; design of piston and piston-rings; design of connecting rod; design of crankshaft.

Unit IV

Design of Miscellaneous Components:-design of Flanged coupling; Rigid coupling, Design of Pressure vessels subjected to internal pressure, external pressure, design of penetration, design of flanges, cone cylinder junctions, Materials, Fabrication.

Unit V

Optimization:- Basic concept of optimization, classification of optimization, optimization Techniques, engineering applications of optimization. Classical optimization techniques: unconstrained optimization single-variable optimization, multivariable optimization, solution by direct search method, solution by Lagrange-multipliers method.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Text Book/References Books/ Websites:

1. Shigley J.E.; Machine Design;TMH
2. BhandariVB; Design of Machine Elements;TMH
3. Sharma CS and Purohit K; Design of Machine Elements; PHILearning.
4. Hall and Somani; Machine Design; Schaum Series;TMH
5. Wentzell TH; Machine Design; CengageLearning
6. Sharma & Agrawal; Machine Design;Katson
7. Kulkarni SG; Machine Design;TMH
8. Abdul Mubeen; Machine Design; KhannaPublishers
9. Juvinall RC, Marshek KM; Fundamentals of Machine Component Design;Wiley
10. Norton R; Design of Machinery;TMH



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

SECOND YEAR-
Semester–VII Course Content & Grade

Branch	Subject Title (Departmental Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	MATERIAL HANDLING EQUIPMENT	ME – 7021 (C)	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1- To discuss the material handling equipments& their applications.

CO2- To study the construction, working & maintenance of traction type conveyors

CO3- To discuss the different components of material handling systems.

CO4- To study the mechanism used in material handling equipment in industries.

UNIT – I

Introduction:-Types of interplant transporting facility, principal groups of material handling equipments, choice of material handling equipment, hoisting equipment, screw type, hydraulic and pneumatic conveyors, general characteristics of hoisting machines, surface and overhead equipments, general characteristics of surface and overhead equipments and their applications.

UNIT – II

Material Handling Equipment:- To control of hoisting equipments, Flexible hoisting appliances like ropes and chains, welded load chains, roller chains, selection of chains hemp rope and steel wire rope, selection of ropes, fastening of chains and ropes , different types of load suspension appliances, fixed and movable pulleys, different types of pulley systems, multiple pulley systems . Chain and rope sheaves and sprockets.

UNIT – III

Load handling attachments:- Standard forged hook, hook weights, hook bearings, cross piece and casing of hook, crane grab for unit and piece loads, carrier beams and clamps, load platforms and side dump buckets, electric lifting magnets, grabbing attachments for loose materials, crane attachments for handling liquid materials.

UNIT – IV

Gear:-Arresting gear, ratchet type arresting gear, roller ratchet, shoe brakes and its different types like electromagnetic, double shoe type, thruster operated, controller brakes, shoe brakes, thermal calculations of shoe brakes and life of linings, safety handles, load operated constant force and variable force brakes general theory of band brakes, its types and construction.

UNIT – V

Cranes:-Cranes with rotary pillar, cranes with a fixed post, jib cranes with trolley, cranes with luffing boom cantilever cranes, cage elevators safety devices of elevators belt and chain conveyors and their power calculations, vibrating and oscillating conveyors pneumatic and hydraulic conveyors, screw conveyors hoppers, gates and feeders. Introduction to AGV s as new material handling device, use of robot for material handling.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

Text Book/References Books/ Websites:

1. Material Handling - Immer J. R. (McGrawHill)
2. Plant Layout & Material Handling - James Apple (JohnWiley)
3. Material Handling System Design - James Apple ((JohnWiley)
4. Material Handling Principles & Practice - Theodore H. Allegra Sr. (CBS Publishers & Distributors)
5. Material Handling- John R. Immer- McGraw Hill Co. Ltd., New York.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

SECOND YEAR- Semester–VII Course Content & Grade

Branch	Subject Title (Departmental Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	HVAC SYSTEM DESIGN	ME – 7021 (C)	3L-1T-0P	4

Course Objectives:

- 1.To understand the principles of Applied Psychrometry, Psychrometric processes using chart Load Estimation.
- 2.To understand Air Distribution.
- 3.To know Ventilation and Infiltration.
- 4.To gain knowledge about Direct and Indirect Evaporative Cooling.
5. To impart knowledge on Air conditioning systems.

UNIT-I

Applied Psychrometry, Psychrometric processes using chart Load Estimation: solar heat gain, study of various sources of the internal and external heat gains, heat losses, etc.

Methods of heat load calculations: Equivalent temperature Difference Method, Cooling Load Temperature Difference, and Radiance Method, RSHF, GSHF, ESHF, etc. Inside and outside design conditions.

UNIT-II

Air Distribution: Fundamentals of air flow in ducts, pressure drop calculations, design ducts by velocity reduction method, equal friction method and static regain method, duct materials and properties, insulating materials, types of grills, diffusers, wall registers.

UNIT-III

Ventilation and Infiltration: Requirement of ventilation air, various sources of infiltration air, ventilation and infiltration as a part of cooling load. Fans and Blowers: Types, performance characteristics, series and parallel arrangement, selection procedure.

UNIT-IV

Direct and Indirect Evaporative Cooling: Basic psychrometric of evaporative cooling, types of evaporative coolers, design calculations, Air Conditioning Equipments and Controls:



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Chillers, Condensing units, Cooling coils, bypass factors, humidifiers, dehumidifiers, various types of filters, air washers, thermostat, humidistat, cycling and sequence controls, modern control of parity, odour and bacteria, Air filtration- Study of different types of filters, Cooling Towers

UNIT-V

Air conditioning systems: Classification, design of central and unitary systems, typical air conditioning systems such as automobile, air plane, ships, railway coach air-conditioning, warm air system, hot water systems, heat pump, clean rooms (descriptive treatments only).

Standards and Codes: ASHRAE/ARI, BIS standards study and interpretation, ECBC, NBC

codes

Course Outcomes:

1. To be able to state the Applied Psychrometry, Psychrometric processes using chart Load Estimation.
2. To be able to identify and describe Fundamentals of air flow in ducts, pressure drop calculations, design ducts by velocity reduction method.
3. To be able to explain at a level understandable by a non-technical person how Requirement of ventilation air, various sources of infiltration air, ventilation and infiltration as a part of cooling load.
4. To be able to apply the Basic psychrometric of evaporative cooling, types of evaporative coolers, design calculations.
5. To be able to apply Classification, design of central and unitary systems, typical air conditioning systems such as automobile, air plane, ships.

REFERENCES:

1. ASHRAE Handbooks
2. ISHRAE Handbook.
3. Handbook of Air Conditioning System Design, Carrier Incorporation, McGraw Hill Book Co., USA.
4. Trane air conditioning manual,
5. Refrigeration and Air conditioning, ARI Prentice Hall, New Delhi.
6. Norman C. Harris, Modern air conditioning
7. Jones W. P., Air conditioning Engineering, Edward Arnold Publishers Ltd, London, 1984.
8. Jones W. P., Air conditioning Engineering - Applications, Edward Arnold Publishers Ltd, London, 1984



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

9. Hainer R. W., Control System for Heating, Ventilation and Air conditioning, Van Nastrand Reinhold Co., New York, 1984.
10. Refrigeration and Air conditioning- C P Arora, Tata McGraw Hill Publication, New Delhi.
11. McQuiston, Faye; Parker, Jerald; Spitler, Jeffrey 2000, Heating, Ventilating and Air Conditioning-Analysis and Design, 5th ed. John Wiley & Sons.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

SECOND YEAR-
Semester–VII Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
ME	SWAYAM/NPTEL-MOOC-5	ME. -7021(D)/Code as per SWAYAM/NPTEL-MOOC	4L-0T-0P	4

Guideline

SWAYAM/NPTEL-MOOC-2 courses is a programme initiated by Government of India and designed to achieve the three cardinal principles of education via, access, equity and quality. The objective of this effort is to take the best teaching resources to all, including the most disadvantaged SWAYAM seeks to bridge divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

Courses delivered through SWAYAM/NPTEL-MOOC courses are available free of cost to the learners, however learners wanting SWAYAM/NPTEL-MOOC courses Certificate should register for the final proctoral exams that come at a fee and attend in-person at designated center on specified dates.

In perspective of the need to create synergist between the salient features of ‘anytime anywhere’ format of e-learning and traditional classrooms chalk and talk method to develop a unique content delivery mechanism which is responsive to learners’ needs and ensuring seamless transfer of knowledge across geographical boundaries. RKDF University proposes to incorporate MOOC courses delivered by SWAYAM/NEPTEL portal. Student can opt any courses from SWAYAM/NPTEL-MOOC courses as an elective Base on following condition

1. He/She has consulted and inform to the departmental coordinator regarding courses selection and mark obtain to him. No Subjected should be repeat from courses which is offer and courses which are selected.
2. He/She can opt from only courses which are not available from University.
3. Only enrollement in the courses and learning from it is free as this is a project supported by MHRD GOI.
4. To get Certificate from SWAYAM-NPTEL. The learner has to separately register and appear for a proctored exam at a fee as decided by host institution/Mooc of Rs. 1000/-



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Which be bearded by Student only.

5. If student successful appear in exam and obtain certificated of courses of 12 week course to earn 3 credits(As recommended by NPTEL) to suffice for required credit for the award of his/her degree.
6. The NPTEL recommended that an additional 1 credit may be awarded given by University. This credited can be given based on attendances, assignment and tutorial work submitted by the students.
7. All students would be motived to take courses online with SWAYAM/NPTEL every semester to better prepared for the future so that they can cultivate the habilt of self-study online. The University propose to implement MOOC courses under Department. The University also made provision if student unable to get certificate He/She still be able to appear in the department elective courses and complete there degree



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

SECOND YEAR-
Semester–VII Course Content & Grade

Branch	Subject Title (Open Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	RELIABILITY ENGINEERING	ME – 7031(A)	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1-Students should be able to understand about what is Reliability.

CO2-Students should be able to understand how to allocate Reliability to each

component CO3-Students should be able to understand what is Maintainability.

CO4-Students should be able to understand about strength-based reliability.

Unit -I

Reliability: Definition Probability Concept; Addition of Probabilities; Complimentary Events; Calculation of Reliability, Reliability analysis.

Unit –II

Failure Data Analysis:- Introduction, Mean Failure Rate, Mean Time to Failure (MTTF), Mean Time between Failures (MTBF), Graphical Plots, MTTF in terms of Failure Density, MTTF in Integral Form.

Unit - III

Conditional Probability:- Introduction, Hazard Rate as conditional probability, Principles of CBM, Pillars of condition monitoring, CBM implementation and benefits, visual monitoring, vibration monitoring, wear debris monitoring, corrosion monitoring, performance monitoring.

Unit - IV

General Maintenance & Management function:- Breakdown, emergency, corrective, predictive, Objectives and evolution of TPM, Effects and Criticality analysis (FMECA), applications and benefits, risk evaluation, risk priority.

Unit - V

Maintainability and Availability:- Introduction, Maintenance Planning & scheduling, Maintenance organization, Tools for better maintenance –preventive, shutdown and Scheduled maintenance.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Text Book/References Books/ Websites:

1. Reliability Engineering, L.Balagurusamy, Tata Mc-Graw Hill, New Delhi, 1984.
2. Reliability Based Design, S.Rao, Mc-Graw Hill, 1992.
3. Reliability in Engineering Design, K.C. Kapur and L.R. Lamberson, Wiley Publications.
4. Reliability Engineering, D.J. Smith, 1972, E.W.Publications.
5. Mishra R.C. Reliability and Maintenance Engineering New age International Publisher.
6. Naikan; Reliability engineering and life testing; PHI
7. Modarre M; Reliability and Risk Analysis, Marcel Dekker Inc CRC Press
8. Reliability Engineering, L.S. Srinath, Affiliated East-West Press, New Delhi.
9. Reliability Engineering, A.K.Govil, Tata Mc-Graw Hill, New Delhi.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-
Semester – VII Course Content & Grade

Branch	Subject Title (Open Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	TRIBOLOGY	ME – 7031(B)	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1-Understand the wear theories, types of wear, mechanism, factors and selection of materials
CO2- To introduce students to the field of teratology.

CO3- To enhance students' awareness of tribological issues in the design of machine components, such as rolling element bearings, journal bearings, thrust bearings, seals, and braking systems.

CO4-Calculate surface topographical parameters of Surface properties & Friction

UNIT - I

Tribological Aspects of Rolling Motion:-Introduction to tribological systems and their characteristic features; analysis and assessment of surface; topography; deterministic and stochastic tribo-models for asperity contacts; techniques of surface examination; technological properties of surfaces. Quantitative laws of sliding friction, causes of friction, adhesion theory, laws of rolling friction, measurement of friction

UNIT - II

Wear:-Introduction, mechanism of wear, types of wear, quantitative laws of wear, measurement of wear, wears resistance materials

UNIT - III

Lubricants:-Introduction, dry friction, boundary lubrication, hydrodynamic, hydrostatic and elasto- hydrodynamic lubrication, functions of lubricants, types and properties, lubricant additives. Principles, application to rolling contact bearings, cams, Gears

UNIT - IV

Bearing Design Consideration & Characteristics:-Geometry and pressure equation of journal bearing, hydrostatic bearings, thrust bearings, porous bearings and hydrodynamic gas bearings. Journal bearings with specialized applications. General requirements and different types of bearing materials.

UNIT - V

Surface Interactions:- Elastic & Plastic deformation of surfaces. Contact of Solids, Contact of Ideally Smooth Surfaces. Distribution of Pressure over elastic contact of two curvilinear bodies. Formulae for calculation of contact area. Physico-Mechanical properties of surface



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

layers, Characteristics of Surface Geometry. Classes of surface roughness. Contact of rough surfaces. Interaction of surface peaks. Real and contour area of contact.

Text Book/References Books/ Websites:

1. Introduction to Tribology of bearings by - B. C. Majumdar., S Chand &Co.
2. Hand Book of Tribology –WHILEY
3. Fundamentals of Fluid film lubrication by –Bernard Hamrock, Mc Graw Hill International Edition.
4. Tribology in Industries by Sushil. K. Srivastava, S Chand &Publications.
5. Basic Lubrication theory by Alastair Cameron



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-
Semester–VII Course Content & Grade

Branch	Subject Title (Open Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	MECHANICAL VIBRATION	ME – 7031(C)	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1-Ability enhancement in analyzing the machine vibrations in various degree of freedom systems. CO2-Ability enhancement in determining the various causes of machine vibrations and noise and in applying the perfect compensatory system to control them.

CO3-Ability enhancement in practically using the different vibrations.CO4-Noise measuring instruments to find the basic causes of machine failures.

UNIT - I

Basic Concepts of Vibration:-Vibration and oscillation, causes and effects of vibrations, Vibration parameters – spring, mass, damper, Damper models, Motion – periodic, non periodic, harmonic, non- harmonic, Degree of freedom, static equilibrium position, Vibration classification, Steps involved in vibration analysis. Free Undamped Single Degree of Freedom Vibration System : Longitudinal, transverse, tensioned system, Methods for formulation of differential equations by Newton, Energy, Lagrangian (Rayleigh's Method), Effect of springs mass and shaft inertia on natural frequency, Effect of flexible bearing on natural frequency.

UNIT - II

Free Damped Single Degree of Freedom Vibration System:-Viscous damped system – under damped, critically damped, over damped; Logarithmic decrement; Coulomb's damping; Combined viscous and coulomb's damping. Equivalent Single Degree of Freedom Vibration System: Conversion of multi- springs, multi masses, multi – dampers into a single spring and damper with linear or rotational coordinate system

UNIT - III

Free Undamped Multi Degree of Freedom Vibration System:-Eigen values and Eigen vectors for linear system and tensional two degree of freedom; Holzer method for linear and tensional unbranched system; Two rotors, Three rotors and geared system; Dunkley and Rayleigh method for transverse vibratory system Forced Single Degree of Freedom Vibratory System: Analysis of linear and tensional systems subjected to



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

harmonic force excitation and harmonic motion excitation (excluding elastic damper)

UNIT- IV

Vibration Measuring Instruments:-Principle of seismic instruments, vibrometer, accelerometer- undamped, damped. Vibration Isolation: Force isolation, motion isolation, isolators. . Rotor Dynamics: Critical speed of single rotor, undamped and damped CAM Dynamics: Cam Dynamics: Mathematical Model, Differential Equation, Response Follower Jump Phenomenon

UNIT - V

Balancing:-Static and dynamic balancing of multi rotor system, balancing of reciprocating masses in – line engines, V – engines (excluding radial engines)

Text Book/References Books/ Websites:

1. Mechanical Vibrations (S.S. Rao) Pearson Education (4thEdition).
2. Mechanical Vibrations (G.K.Grover).
3. Fundamentals of Mechanical Vibration (S. graham Kelly) Tata McGrawHill.
4. Mechanical Vibration Analysis (P. srineevasan) Tata McGrawHill.Mechanical Vibrations – Schaum'sOutline Series (S. Graham Kelly) McGrawHill.
5. Mechanical Vibrations– Schaum'sOutline Series (William W. Seto) McGrawHill.
6. Practice of Mechanical Vibrations (J.S. Rao, K. Gupta) New AgeInternational



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

SECOND YEAR-
Semester–VII Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
ME	SWAYAM/NPTEL-MOOC-6	ME. -7031(D)/Code as per SWAYAM/NPTEL-MOOC	4L-0T-0P	4

Guideline

SWAYAM/NPTEL-MOOC-2 courses is a programme initiated by Government of India and designed to achieve the three cardinal principles of education via, access, equity and quality. The objective of this effort is to take the best teaching resources to all, including the most disadvantaged SWAYAM seeks to bridge divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

Courses delivered through SWAYAM/NPTEL-MOOC courses are available free of cost to the learners, however learners wanting SWAYAM/NPTEL-MOOC courses Certificate should register for the final proctoral exams that come at a fee and attend in-person at designated center on specified dates.

In perspective of the need to create synergist between the salient features of ‘anytime anywhere format of e-learning and traditional classrooms chalk and talk method to develop a unique content delivery mechanism which is responsive to learners’ needs and ensuring seamless transfer of knowledge across geographical boundaries. RKDF University proposes to incorporate MOOC courses delivered by SWAYAM/NEPTEL portal. Student can opt any courses from SWAYAM/NPTEL-MOOC courses as an elective Base on following condition

1. He/She has consulted and inform to the departmental coordinator regarding courses selection and mark obtain to him. No Subjected should be repeat from courses which is offer and courses which are selected.
2. He/She can opt from only courses which are not available from University.
3. Only enrollement in the courses and learning from it is free as this is a project supported by MHRD GOI.
4. To get Certificate from SWAYAM-NPTEL. The learner has to separately register and appear for a proctored exam at a fee as decided by host institution/Mooc of Rs.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

1000/-Which be bearded by Student only.

5. If student successful appear in exam and obtain certificated of courses of 12 week course to earn 3 credits(As recommended by NPTEL) to suffice for required credit for the award of his/her degree.
6. The NPTEL recommended that an additional 1 credit may be awarded given by University. This credited can be given based on attendances, assignment and tutorial work submitted by the students.
7. All students would be motivated to take courses online with SWAYAM/NPTEL every semester to better prepared for the future so that they can cultivate the habilt of self-study online. The University propose to implement MOOC courses under Department. The University also made provision if student unable to get certificate He/She still be able to appear in the department elective courses and complete there degree



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR- Semester–VII Course Content & Grade

Branch	Subject Title (Departmental Elective Lab)	Subject Code	Contact Hours per Week	Total Credit
ME	AUTOMOBILE ENGINEERING	ME – 7041(A)	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to,

CO1- Understand the Construction, working and other details about Internal Combustion Engines used in automobiles.

CO2- Identify Construction, working, preventive maintenance, trouble shooting and diagnosis of various Automobile Systems.

CO3- Understand importance and features of different systems like axle, differential, brakes, steering, suspension, and balancing etc.

CO4- Identify Modern technology and safety measures used in Automotive Vehicles.

Suggested List of Laboratory Practical (Expandable):

1. To study and prepare report on the constructional details, working principles and operation of the following automotive clutches: (a) Coil –Spring clutch, (b) Diaphragm spring clutch, (c) Double disk clutch
2. To study and prepare report on the constructional details, working principles and operation of the following automotive transmission systems: (a) Synchromesh – four speed rang, (b) Transaxle with dual speed range, (c) Four wheel drive and transfer case, (d) Steering column and floor shift- lever
3. To study and prepare report on the constructional details, working principles and operation of the following automotive tires & wheel: (a) Various types of bias and radial plies tires, (b) Various types of wheels
4. To study and prepare report on the constructional details, working principles and operation of the following automotive steering systems: (a) Manual steering system, e.g. pitman arm steering, rack and pinion steering Power steering system, e.g. rack & pinion power steering systems © Steering wheels & column, e.g. tilt and telescopic steering wheels, collapsible steering columns
5. To study and prepare report on the constructional details, working principles and operation of the following automotive brake systems: (a) Hydraulic & pneumatic brake system, (b) Drum brake system, Disk brake system Antilock brake system
6. To study and prepare report on the constructional details, working principles and operation of the following automotive suspension systems: (a) Front suspension system, (b) Rear suspension system
7. To study and prepare report on the constructional details, working principles and operation of the following automotive drive lines and differentials: (a) Rear wheel drive line, (b) Front wheel drive line, (c) Differential, drive axel and four wheel drive line.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

8. To study and prepare report on the constructional details, working principles and operation of the automotive emission / pollution control systems.
9. To study and prepare report on the constructional details, working principles and operation of the following automotive fuel supply systems: (a) Carburetor, (b) Diesel fuel injection systems, (c) Gasoline fuel injection systems
10. To study and prepare report on the constructional details, working principles and operation of the following automotive engine systems and sub systems: (a) Multi cylinder: diesel and petrol engine, (b) Engine cooling and lubricating systems, (c) Engine starting systems, (d) Contact point and electronic ignition



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester-VII
Course Content & Grade

Branch	Subject Title (Departmental Elective Lab)	Subject Code	Contact Hours per Week	Total Credit
ME	MECHANICAL SYSTEM DESIGN LAB	ME – 7041(B)	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to,

CO1- Apply knowledge of different types of machine parts and its attachments.

CO2- Apply applications of computer programming of different linkage and its Factor of Safety.

CO3- Understand different creep of creep and fatigue principles in machine parts. CO4- Understand different types of brakes and clutches in practical applications.

Suggested List of Laboratory Practical's (Expandable)-

1. Study and determine the length of flat belt drive and rope drive.
2. Study different types of gear drive.
3. Study of different types of I.C. Engine components.
4. Study of Bush Pin type flexible coupling and Hooks Joints.
5. Study of thick and thin cylinder for Hoop and Longitudinal stress.
6. Study of different types of optimization Techniques in mechanical system design.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester–VII
Course Content & Grade

Branch	Subject Title (Departmental Elective Lab)	Subject Code	Contact Hours per Week	Total Credit
ME	MATERIAL HANDLING EQUIPMENT LAB	ME – 7041(C)	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to, CO1- Apply different types of material handling equipment in industry.
CO2- Understand different types of material handling conveyers and Host in factory.
CO3- Apply different types Hooks and cranes for small and heavy load in industry.
CO4- Apply different types of AGV in different types of industry.

Suggested List of Laboratory Practical (Expandable):

1. Study of different types of hydraulic and pneumatic conveyors.
2. Study of different types Chain and rope sheaves and sprockets.
3. Study of different types of Cranes and lifting machines in industry.
4. Study of different types of gears and clutches in machinery.
5. Study of different pneumatic and hydraulic conveyors.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-
Semester–VII Course Content & Grade

Branch	Subject Title (Open Elective Lab)	Subject Code	Contact Hours per Week	Total Credit
ME	RELIABILITY ENGINEERING LAB	ME – 7051(A)	0L-0T-2P	2

Course Outcomes: After studying this course,

students will be able to, CO1-Students should

be able to understand Addition of

Probabilities.

CO2-Students should be able to understand Mean Time to Failure (MTTF).

CO3-Students should be able to understand Hazard Rate as conditional probability.

CO4-Students should be able to understand Effects and Criticality analysis.

Suggested List of Laboratory Practical (Expandable):

1. Study of reliability availability an Maintainability.
2. Study of Mean Time to Failure (MTTF) analysis with help of graph.
3. Study of visual monitoring system.
4. Study of different types of breakdown system in industry.
5. Study of different types of maintenance system in different types of machines,



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-
Semester–VII Course Content & Grade

Branch	Subject Title (Open Elective Lab)	Subject Code	Contact Hours per Week	Total Credit
ME	TRIBOLOGY LAB	ME – 7051(B)	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to,

CO1-Understand the tribological systems

and their characteristic features. CO2- To

Understand mechanism of wear.

CO3- To Understand the Lubrication System.

CO4-To Understand Bearing Design Consideration & Characteristics.

Suggested List of Laboratory Practical (Expandable):

1. To study Tribological Rolling Motion in machinery.
2. To study Wear Mechanism in different industry.
3. To study of different types of Lubrication system in machinery.
4. To study of Bearing Design Consideration & its Characteristics.
5. Characteristics of Surface Texture Geometry in different types of surfaces.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

**FOURTH YEAR-
Semester–VII Course Content & Grade**

Branch	Subject Title (Open Elective Lab)	Subject Code	Contact Hours per Week	Total Credit
ME	MECHANICAL VIBRATION LAB	ME – 7051(C)	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to,

CO1- Apply knowledge of different types Linkage mechanisms in kinematic chain. CO2- Apply applications of Governors and Gyroscope in different machinery.
CO3- Understand different types of sliding and rolling element bearing.
CO4- Understand the principle of Critical speed of shaft in single and multi rotor system.

Suggested List of Laboratory Practical (Expandable):

1. Determination of natural frequency of a spring mass system.
2. Determination of natural frequency logarithmic decrement, damping ratio and damping Co-efficient in a single degree of freedom vibrating systems (longitudinal and tensional).
3. Determination of critical speed of rotating shaft.
4. Study of Balancing of rotating masses.
5. Determination of fringe constant of Photo-elastic material using Circular disk subjected diametric compression, Pure bending specimen (four point bending)
6. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Hartnell Governor.
7. Determination of pressure distribution in Journal bearing.
8. Designing and sketching of components contained in the syllabus



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-
Semester–VII Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	MAJOR PROJECT-I	ME - 7061	0L-0T-4P	4

Course Outcomes: After studying this course, students will be able to,
CO1- Enable the Students to undertake short research projects in a team under the direction of members of the faculty
CO2-To impart skills in preparing detailed report describing the project and results.
CO3- To enable the students to undertake fabrication work of new experimental set up/devices or develop software packages
CO4-To effectively communicate by making an oral presentation before an evaluation committee

Contents (Theory)

Students shall be encouraged to form groups (Maximum 5) to do a Minor Project on technical topic of concern branch. The student should prepare a working system or some design or understanding of a complex system (on minor level) that he has selected for his/her minor project work using system analysis tools and submit the same in the form of a write-up i.e. detail project report. The student should maintain proper documentation of different stages of project such as concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan wherever applicable. Each student is required to prepare a project report based on the above points and present the same at the final examination with a demonstration of their project.

Text Book/References Books/ Websites: Nil

Suggested List of Laboratory Experiments :- (Expandable): Nil



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester-VIII
Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	REFRIGERATION & AIR CONDITIONING	ME - 8011	3L-1T-2P	6

Course Outcomes: After studying this course, students will be able to,

- CO1-Students should be able to understand various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables
- CO2-Students should be able to illustrate the fundamental principles and applications of refrigeration and air conditioning system
- CO3-Students should be able to obtain cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration systems
- CO4-Students should be able to present the properties, applications and environmental issues of different refrigerants

UNIT-I

Introduction: Principles and methods of refrigeration, freezing; mixture cooling by gas reversible expansion, throttling, evaporation, Joule Thomson effect and reverse Carnot cycle; unit of refrigeration, coefficient of performance, vortex tube & thermoelectric refrigeration, adiabatic demagnetization; air refrigeration cycles- Joule's cycle Boot-strap cycle, reduced ambient cycle and regenerative cooling cycles.

UNIT-II

Vapour compression system: Vapor compression cycle, p-h and t-s diagrams, deviations from theoretical cycle, sub-cooling and super heating, effects of condenser and evaporator pressure on cop; multi-pressure system: removal of flash gas, multiple expansion & compression with flash inter cooling; low temperature refrigeration: production of low temperatures, cascade system, dry ice, production of dry ice, air liquefaction system,.

UNIT-III

- (a) **Vapor absorption system:** Theoretical and practical systems such as aqua-ammonia, electrolux & other systems;
- (b) **Steam jet refrigeration:** Principles and working, simple cycle of operation, description and working of simple system,
- (c) **refrigerants:** nomenclature & classification, desirable properties, common refrigeration, comparative study, leak detection methods, environment friendly refrigerants and refrigerant mixtures, brine and its properties



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

UNIT-IV

Psychometric: Calculation of psychometric properties of air by table and charts; psychrometric processes: sensible heating and cooling, evaporative cooling, cooling and dehumidification, heating and humidification, mixing of air stream, sensible heat factor; principle of air conditioning, requirements of comfort air conditioning, ventilation standards, infiltrated air load, fresh air load human comfort, effective temperature & chart, heat production & regulation of human body,

UNIT-V

Air conditioning loads: calculation of summer & winter air conditioning load, bypass factor of coil, calculation of supply air rate & its condition, room sensible heat factor, grand sensible heat factor, effective sensible heat factor, dehumidified air quantity. Problems on cooling load calculation. Air distribution and ventilation systems.

Text Book/References Books/ Websites:

1. Arora CP; Refrigeration and Air Conditioning; TMH
2. Sapali SN; Refrigeration and Air Conditioning; PHI
3. Ananthanarayan; Basic Refrigeration and Air conditioning; TMH
4. Manohar Prasad; Refrigeration and Air Conditioning; New Age Pub
5. Ameen; Refrigeration and Air Conditioning; PHI
6. Pita ; Air conditioning Principles and systems: an energy approach; PHI
7. Stoecker W.F, Jones J; Refrigeration and Air conditioning; McGH, Singapore

Suggested List of Laboratory Practical (Expandable):Study & Performance of basic vapour compression Refrigeration Cycle

1. To find COP of water cooler
2. To study and perform experiment on vapour absorption apparatus.
3. To find the performance parameter of cooling tower.
4. To study various components in room air conditioner.
5. To find performance of a refrigeration test rig system by using different expansion devices.
6. To study different control devices of a refrigeration system.
7. To study various compressor.
8. To find the performance parameters of Ice Plant.
9. Perform the experiment & calculate various Performance parameters on a blower apparatus.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR Semester–VIII

Course Content & Grade

Branch	Subject Title (Departmental Elective-IV)	Subject Code	Contact Hours per Week	Total Credit
ME	I.E. & OPERATION RESEARCH	ME – 8021 (A)	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1-Students will be proficient to recognize the importance and value of Operations Research and mathematical modeling in solving practical problems in industry by Linear programming problems

CO2-Planning and controlling of production system and use of modern forecasting and management techniques for different types of industries

CO3-Students will be able to understand queuing & sequencing models and apply them to real-life problems

CO4-Students will be capable to understand the mathematical tools that are needed to formulate & solve transportation problems for optimization

Unit - I

Linear system and distribution models: Mathematical formulation of linear systems by LP, solution of LP for two variables only, special cases of transportation and assignment and its solution, Vogel's forward looking penalty method, cell evaluation degeneracy, use of SW Lindo, Tora, Excell.

Unit - II

Supply chain (SCM): Definition, importance, expenditure and opportunities in SCM; integration of inbound, outbound logistics and manufacturing to SCM, flow of material money and information, difficulties in SCM due to local v/s system wide (global) optimization and uncertainties in demand and transportation; Bull-whip effect; customer value; IT, info-sharing and strategic partnerships; plant and warehouse-network configuration; supply contracts and revenue sharing; outsourcing; transportation, cross docking and distribution, forecasting models in SCM; coordination and leadership issues; change of purchasing role and vendor rating, variability from multiple suppliers.

Unit - III

Inventory models: Necessity of inventory in process and safety stock, problem of excess inventory and cycle time (=WIP/ Throughput), JIT/ lean mfg; basic EOQ/ EPQ models for constant review Q- system(S,s); periodic review, base stock P-system; service level, lead time variance and safety stock;; ABC, VED and other analysis based on shelf life,



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

movement, size, MRP technique and calculations, lot sizing in MRP, linking MRP with JIT; evolution of MRP to ERP to SCM and e-business.

Unit - IV

- (a) **Waiting Line Models** Introduction, Input process, service mechanism, Queue discipline, single server (M/M/1) average length and times by Little's formula, optimum service rate; basic multiple server models (M/M/s)
- (b) **Competitive strategy:** concept and terminology, assumptions, pure and mixed strategies, zero sum games, saddle point, dominance, graphical, algebraic and LP methods for solving game theory problems.

Unit - V

- (a) **Decision analysis:** decision under certainty, risk probability and uncertainty; Hurwicz criteria; AHP- assigning weight and consistency test of AHP
- (b) **Meta-heuristics** Definition of heuristic and meta-heuristic algorithms; introduction to Tabu search, Simulated Annealing and Genetic algorithms and solution of traveling salesman and non linear optimization problems.

Text Book/References Books/ Websites:

1. Hillier FS and Liberman GJ; Introduction to Operations Research concept and cases; TMH
2. Simchi-Levi, Keminsky; Designing and managing the supply chain; TMH.
3. Srinivasan G; Quantitative Models In Operations and SCM; PHI Learning
4. Mohanty RP and Deshmukh SG; Supply Chain Management; Wiley India
5. Taha H; Operations research; PHI
6. Sen RP; Operations Research-Algorithms and Applications; PHI Learning
7. Sharma JK; Operations Research; Macmillan
8. Ravindran , Philips and Solberg; Operations research; Wiley India
9. Vollman, Berry et al; Manufacturing planning and control for SCM; TMH.
10. Bowersox DJ, Closs DJ, Cooper MB; Supply Chain Logisti Mgt; TMH
11. Burt DN, Dobler DW, StarlingSL; World Class SCM; TMH
12. Bronson R ;Theory and problems of OR; Schaum Series; TMH



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester-VIII

Course Content & Grade

Branch	Subject Title (Departmental Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	SOLAR ENERGY UTILISATION	ME – 8021(B)	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1-Gain an understanding of the available solar energy and the current solar energy conversion and utilization processes.

CO2-Have a working knowledge of semiconductor physics, optical systems, photovoltaic engineering, load matching, and storage and grid connections.

CO3-Be able to comprehend the challenges in sustainable energy processes, perform cost analysis, design photovoltaic systems for different applications meeting residential and industrial needs, predict and test performance,

CO4-Understand the manufacturing processes involved, environmental challenges that need to be solved, economic aspects, and future potentials.

UNIT-I

Energy resources and their utilization: Indian and global energy sources, Energy exploited, Energy planning, Energy Parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation.

UNIT-II

Solar radiations: Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Flux on a plane surface, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.

UNIT-III

Solar energy: Radiation, flat plate and concentrating collectors, fluid flow and heat transfer analysis, estimation of solar radiation, Active systems, solar pond, passive space conditioning, power generation, photovoltaic's. Principles and applications of wave energy, tidal energy, biomass energy, OTEC and Geothermal energy. MHD Engineering. Fuel Cells. Wind Energy potentials.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

UNIT-IV

Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping, power generation schemes.

UNIT-V

Other Non- Conventional energy sources: Geothermal energy – Introduction, Types of geothermal resources, Methods of Harnessing. Energy from oceans – wave energy, energy conversion devices, tidal energy- Types of tidal power plants, ocean thermal energy – Introduction, open & closed systems.

Text Book/References Books/ Websites:

1. Solar Energy – S.P.Sukhatme, Tata mcgraw hill co.
2. Power Plant Engineering – P.K.Nag, Tata mcgraw hill publishing co.
3. Kothari, Singal & Rajan; Renewable Energy Sources and Emerging Technologies, PHI Learn
4. Solar Energy Fundamentals Design, Modelling and Applications by G.N. Tiwari, Nwrosh.
5. Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata Mc Graw Hill.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester-VIII

Course Content & Grade

Branch	Subject Title (Departmental Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	SIMULATION & MODELLING-II	ME – 8021(C)	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1- The student will be able to appreciate the utility of the tools like ANSYS or FLUENT in solving real time problems and day to day problems

CO2- Use of these tools for any engineering and real time applications.

CO3- Acquire knowledge on utilizing these tools for a better project in their curriculum as well as they will be prepared to handle industry problems with confidence when it matters to use these tools in their employment.

Unit - I

Introduction to Modeling and Simulation: Modeling and simulation methodology, system modeling, concept of simulation; gaming; static, continuous and discrete event simulation.

Unit - II

Basic Concept of Probability: Generation and characteristics of random variables, continuous and discrete variables and their distributions; mapping uniform random variables to other variable distributions; linear, nonlinear and stochastic models

Unit - III

Introduction to Queuing Theory: Characteristics of queuing system, Poisson's formula, birth death system, equilibrium of queuing system, analysis of M/M/1 queues. Introduction to multiple server Queue models M/M/c Application of queuing theory in manufacturing and computer system

Unit - IV

System Dynamics Modeling: Identification of problem situation, preparation of causal loop diagrams and flow diagrams, equation writing, level and rate relationship, Simulation of system dynamics models.

Unit - V

Verification and Validation: Design of simulation experiments, validation of experimental models, testing and analysis. Simulation languages comparison and selection, study of simulation software Arena, Pro- model, SIMULA, DYNAMO, STELLA, POWERSIM.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Text Book/References Books/ Websites:

1. Law AM and Kelton WD; Simulation Modeling and Analysis; TMH
2. Gordon G., System simulation, PHI Learningl
3. Banks J; Hand book of Simulation; John Wiley.
4. Harrell C, Ghosh B, Bowden R; Simulation Using Promodel; MG Hill
5. Seila, Ceric and Tadikmalla; Applied Simulation Modeling, Cengage
6. Payer T., Introduction to system simulation, McGraw Hill.
7. Sushil, System Dynamics, Wiley Eastern Ltd.
8. Spriet JA; Computer Aided Modeling and Simulation, Academic Press INC; USA



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester-VIII Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
ME	SWAYAM/NPTEL-MOOC-7	ME. -8021(D)/Code as per SWAYAM/NPTEL-MOOC	4L-0T-0P	4

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R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

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R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester-VIII

Course Content & Grade

Branch	Subject Title (Open Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	ROBOTICS	ME – 8031 (A)	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to, CO1- Apply the basic concepts of Robots

CO2- Apply and evaluate the concepts of Kinematics of Robotics. CO3- Apply the Motions, velocities and dynamic analysis of force. CO4- Apply and evaluate Motion planning

Unit – I

Introduction: Automation and Robotics, CAD/CAM and Robotics - An over view of Robotics – present and future applications - classification by coordinate system and control system. Need an importance, basic concepts, structure and classification of industrial robots

Unit – III

Components of the Industrial Robotics: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom - Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

Unit – IV

Robot programming: languages and software packages, Piezoelectric sensors , linear position and displacement sensing, revolvers, encoders, velocity measurement, proximity, tactile, compliance and range sensing. Image processing and object recognition.

Unit – II

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Unit – V

Safety and Economy of Robots: Work cycle time analysis, economics and effectiveness of robots, safety systems and devices, concepts of testing methods and acceptance rule for industrial robots.

Text Book/References Books/ Websites:

1. Mittal RK, Nagrath IJ; Robotics and Control; TMH
2. Industrial Robotics / Groover M P /Pearson Edu
3. Spong Mark and Vidyasagar; Robot Modelling and control; Wiley India
4. Yoshikawa ; Foundations of Robotics- analysis and Control; PHI Learning;
5. Murphy ; Introduction to AI Robotics; PHI Learning
6. Ghosal Ashitava; Robotics Fundamental concepts and analysis; Oxford
7. Saha S; Introduction to Robotics; TMH



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester–VIII Course Content & Grade

Branch	Subject Title (Open Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	QUALITY MANAGEMENT & CONTROL	ME – 8031(B)	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,
CO1- To realize the importance of significance of quality CO2- Manage quality improvement teams
CO3- Identify requirements of quality improvement programs

UNIT - I

Introduction: Basic concepts, definitions and history of quality control. Quality function and concept of quality cycle. Quality policy and objectives. Economics of quality and measurement of the cost of quality. Quality considerations in design. Process control: Machine and process capability analysis. Use of control charts and process engineering techniques for implementing the quality plan. Acceptance Sampling: single, double and multiple sampling, lot quality protection, features and types of acceptance sampling tables.

UNIT-II

Management duration and Control: Importance and options to accelerate project completion; time cost tradeoff; fixed variable and total costs; use of floats and cost optimization; project performance measures; project monitoring info and reports; project control process; Gant chart and control chart cost-schedule S-graph; planned cost of work schedule (PV), budgeted/ earned cost of work (EV) and actual cost of work completed (AC).

UNIT-III

Quality Organization, Culture and Leadership: projects within functional organization; dedicated project/ task-force teams; staff, matrix and network organization;; Organization culture; ten characteristics; cultural dimensions supportive to projects; social network and management by wandering around (MBWA);; five stage team development model; shared vision; conflicts; rewards; rejuvenating project teams; project stakeholders; concept of project partnering.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

UNIT-IV

Strategic Planning and Project Appraisal: Capital allocation key criteria; Porters competitive strategy model; BCG matrix; Strategic Position Action Evaluation (SPACE); time value of money; cash flows; payback period; IRR; cost of capital; NPV; social cost benefit analysis; UNIDO approach; project risks and financing.

UNIT-V

Defect Diagnosis and Prevention : Basic causes of failure, curve/control of failure. **MTBF.** Maintainability, Condition monitoring and diagnostic techniques. different traits of a manager and leader; managing project teams, choosing appropriate project organization.

Text Book/References Books/ Websites:

1. Prasana Chandra: Projects: planning Implementation control; TMH.
2. Gray Clifford F And Larson EW; Project The managerial Process; TMH
3. Panneerselvam and Serthil kumar; Project management, PHI
4. Burke ; Project Management-Planning and control technics; Wiley India
5. Kamaraju R; Essentials of Project Management; PHI Learning



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester-VIII
Course Content & Grade

Branch	Subject Title (Open Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	RAPID PRODUCT DEVELOPMENT	ME – 8031(C)	3L-1T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1: Describe product development, conceptual design and classify rapid prototyping systems; explain stereo lithography process and applications.

CO2: Explain Geometric modeling, Types of Geometric models and Solid Models. CO3: Demonstrate Virtual augmented reality.

CO4: Discuss NC, CNC processes; point out the application of RP system in medical field define virtual prototyping and identify simulation components.

UNIT - I

Introduction: Influence of Innovations on Product Development, Impact on economy, export competitiveness, design as a strategy to win international market and Innovation process.

UNIT - II

Virtual Prototyping and Testing: Geometric modeling, Types of Geometric models and Solid Models Virtual augmented reality, Requirement of devices and technologies and applications Computer Aided Engineering.

UNIT -III

Physical Prototyping and Rapid Manufacturing Computer Numerical Control: Comparison between NC and conventional machines features of CNC Machine Tool and programming.

UNIT –IV

Rapid Tooling: Indirect rapid tooling process.

UNIT - V

Rapid Prototyping and Rapid Tooling: Methods, Stereo lithography, Fused-deposition modeling, Selective laser sintering, Laminated-object manufacturing, Ballistic particle manufacturing, Solid base



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

curing and Direct manufacturing and rapid tooling.

Text Book/References Books/ Websites

1. Chua C.K., Leong K.F. and Lim C.S., “Rapid Prototyping: Principles and Applications”, 3e, World scientific publications, 2010.
2. Paul F Jacobs, “Rapid Prototyping and manufacturing–Fundamentals of stereolithography”, Society of Manufacturing Engineering Dearborn, USA 1992
3. Pham,D.T. and Dimov.S.S., “Rapid manufacturing” , Springer, London, 2001. 2. Joe Cecil, “Virtual Engineering” , Momentum Press, 2010.



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester-VIII
Course Content & Grade

Branch	Subject Title (Open Elective)	Subject Code	Contact Hours per Week	Total Credit
ME	Advanced Refrigeration	ME – 8031(D)	3L-1T-0P	4

Course Contents

Unit-1

Refrigeration Systems: Vapor compression; multiple evaporator and compound compression system with and without inter-cooling; dual compressors; cascade systems; vapour absorption system analysis.

Unit-2

Solid carbon dioxide: Principles of production; three-stage system with water and flash intercooler; pressure snow chambers; regenerative liquid pre-cooler; binary system. Cryogenics:

Unit-3

Engineering applications; properties of substances at cryogenic temperature; ortho-para conversion of hydrogen; properties of helium; Lambda point; superfluidity.

Unit-4

Liquefaction of gases: Minimum work cycle; Linde and Claude method; use of pre-cooling; liquefaction of hydrogen and neon liquefaction of helium; separation of gases from the air. Insulation, storage and transport of cryogenic fluids; magnetic and nucleate cooling.

Unit-5

Pressure Drop and Heat Transfer: Two-phase flow; flow regimes; maps pressure drop in evaporator and condensers; Martinelli approach. Heat transfer, boiling in flooded evaporators; forced convection evaporation in tubes; inside and outside condensation for vertical and horizontal tubes

Recommended Readings

1. Text book -
2. Reference book1. Mechanical Refrigeration, C.C. Sparks, N R & Dillio, McGraw- Hill, 1959.
2. Cryogenic Systems, Randall F. Barron, McGraw- Hill, 1966
3. ASHRAE Handbook (Fundamentals), ASHRAE
4. Thermal Environmental Engineering, Threlkeld, Prentice Hall, 1998
5. Convective Boiling and Condensation, John G. Collier, McGraw -Hill, 1981
6. Refrigeration and Air conditioning, C.P. Arora, Mc-Graw-Hill, 2017



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester–VIII
Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
ME	SWAYAM/NPTEL- MOOC-7	ME. -8031(E)/Code as per SWAYAM/NPTEL- MOOC	4L-0T-0P	4

Guideline

SWAYAM/NPTEL-MOOC-2 courses is a programme initiated by Government of India and designed to achieve the three cardinal principles of education via, access, equity and quality. The objective of this effort is to take the best teaching resources to all, including the most disadvantaged SWAYAM seeks to bridge divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

Courses delivered through SWAYAM/NPTEL-MOOC courses are available free of cost to the learners, however learners wanting SWAYAM/NPTEL-MOOC courses Certificate should register for the final proctoral exams that come at a fee and attend in-person at designated center on specified dates.

In perspective of the need to create synergist between the salient features of ‘anytime anywhere’ format of e-learning and traditional classrooms chalk and talk method to develop a unique content delivery mechanism which is responsive to learners’ needs and ensuring seamless transfer of knowledge across geographical boundaries. RKDF University proposes to incorporate MOOC courses delivered by SWAYAM/NEPTEL portal. Student can opt any courses from SWAYAM/NPTEL-MOOC courses as an elective Base on following condition

1. He/She has consulted and inform to the departmental coordinator regarding courses selection and mark obtain to him. No Subjected should be repeat from courses which is offer and courses which are selected.
2. He/She can opt from only courses which are not available from University.
3. Only enrollement in the courses and learning from it is free as this is a project supported by MHRD GOI.



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

4. To get Certificate from SWAYAM-NPTEL. The learner has to separately register and appear for a proctored exam at a fee as decided by host institution/Mooc of Rs. 1000/-Which be bearded by Student only.
5. If student successful appear in exam and obtain certificated of courses of 12 week course to earn 3 credits(As recommended by NPTEL) to suffice for required credit for the award of his/her degree.
6. The NPTEL recommended that an additional 1 credit may be awarded given by University. This credited can be given based on attendances, assignment and tutorial work submitted by the students.
7. All students would be motived to take courses online with SWAYAM/NPTEL every semester to better prepared for the future so that they can cultivate the habilt of self-study online. The University propose to implement MOOC courses under Department. The University also made provision if student unable to get certificate He/She still be able to appear in the department elective courses and complete there degree



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester–VIII
Course Content & Grade

Branch	Subject Title (Departmental Elective Lab)	Subject Code	Contact Hours per Week	Total Credit
ME	INDUSTRIAL ENGINEERING & OPERATION RESEARCH	ME – 8041(A)	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to,

CO1: Analyze any real life system with limited constraints and depict it in a model form.

CO2: Understand variety of problems such as assignment, transportation, travelling salesman etc. CO3: Solve the problems using linear programming approach using software.

CO4: Simulate different real life probabilistic situations using Monte Carlo simulation technique.

Suggested List of Laboratory Practical (Expandable):

1. To Study & Prepare Operation Process Chart (OPC) for given assembly.
2. To study & Prepare Man-Machine Chart for the given situation.
3. To study & Calculate standard time for given job.
4. To study & Construct X bar- R Chart for given process.
5. To study & Construct P-chart for given process.
6. To study & Construct C-chart for given process



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester–VIII
Course Content & Grade

Branch	Subject Title (Departmental Elective Lab)	Subject Code	Contact Hours per Week	Total Credit
ME	SOLAR ENERGY UTILIZATION	ME – 8041(B)	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to,

CO1. Conceptual knowledge of the technology, economics and regulation related issues associated with solar power development and management

CO2. Ability to analyse the viability of solar power projects. CO3. Explain the field applications of solar energy.

CO4. Advocacy of strategic and policy recommendations on usage of solar power

Suggested List of Laboratory Practical (Expandable):

1. To study solar photovoltaic system.
2. To study about solar lighting.
3. To study about solar pumping.
4. To study about solar fencing.
5. To study solar cooker.
6. To study solar drying system.
7. To study solar distillation.
8. To study solar pond



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester-VIII

Course Content & Grade

Branch	Subject Title (Departmental Elective Lab)	Subject Code	Contact Hours per Week	Total Credit
ME	SIMULATION & MODELING-II	ME – 8041(C)	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to,
CO1.The student will be able to appreciate the utility of the tools like ANSYS or FLUENT in solving real time problems and day to day problems.

CO2. Use of these tools for any engineering and real time applications.

CO3. Acquire knowledge on utilizing these tools for a better project in their curriculum as well as they will be prepared to handle industry problems with confidence when it matters to use these tools in their employment.

CO4. Validate output from model to check feasibility of implementations.

Suggested List of Laboratory Practical (Expandable):

1. To Study Monte-Carlo Simulation.
2. To Study Simulation of Single Server Queuing System.
3. To Study Simulation of Two-Server Queuing System.
4. To Study Simulate and control a conveyor belt system.
5. Computer Generation of Random Numbers.
6. Test for Standard Normal Distribution.
7. Simulate and control a conveyor belt system



R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester-VIII

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
ME	SWAYAM/NPTEL-MOOC-8	ME. -8041(E)/Code as per SWAYAM/NPTEL-MOOC	4L-0T-0P	4

Guideline

SWAYAM/NPTEL-MOOC-2 courses is a programme initiated by Government of India and designed to achieve the three cardinal principles of education via, access, equity and quality. The objective of this effort is to take the best teaching resources to all, including the most disadvantaged SWAYAM seeks to bridge divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

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In perspective of the need to create synergist between the salient features of ‘anytime anywhere’ format of e-learning and traditional classrooms chalk and talk method to develop a unique content delivery mechanism which is responsive to learners’ needs and ensuring seamless transfer of knowledge across geographical boundaries. RKDF University proposes to incorporate MOOC courses delivered by SWAYAM/NEPTEL portal. Student can opt any courses from SWAYAM/NPTEL-MOOC courses as an elective Base on following condition

1. He/She has consulted and inform to the departmental coordinator regarding courses selection and mark obtain to him. No Subjected should be repeat from courses which is offer and courses which are selected.
2. He/She can opt from only courses which are not available from University.
3. Only enrollement in the courses and learning from it is free as this is a project supported by MHRD GOI.
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R.K.D.F. UNIVERSITY, BHOPAL

B.Tech. (Mechanical Engineering)

New Scheme Based On AICTE Flexible Curricula

Which be bearded by Student only.

5. If student successful appear in exam and obtain certificated of courses of 12 week course to earn 3 credits(As recommended by NPTEL) to suffice for required credit for the award of his/her degree.

6. The NPTEL recommended that an additional 1 credit may be awarded given by University. This credited can be given based on attendances, assignment and tutorial work submitted by the students.

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R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester–VIII
Course Content & Grade

Branch	Subject Title (Departmental Elective Lab)	Subject Code	Contact Hours per Week	Total Credit
ME	Design of Thermal Systems	ME – 8041(D)	0L-0T-2P	2

Unit-1

Mathematical Modeling of thermal Systems: Development of equations based on number-processing

Unit-2

operation and physical laws for simulation and optimization of thermal systems.

Unit-3

The art of equation fitting to performance data; development of performance equations for heat exchangers, distillation separators and turbo machinery.

Unit-4

Simulation of thermal Systems: Uses of system simulation, classes of simulation; Information-flow diagrams; sequential and simultaneous calculations; simulation of continuous, deterministic steady-state systems, e.g., gas turbine system; simulation of dynamic behavior of thermal systems.

Unit-5

Optimization of Thermal Systems: Optimization criteria; use of Lagrange Multipliers, search methods, dynamic programming and geometric programming for optimum design of thermal systems

Text book -

1. W.F. Stocker; “Design of thermal Systems”, McGraw Hill International, 1989.
2. C. Balaji, “Essentials of Thermal System Design and Optimization”, Ane Books Pvt. Ltd
2. Reference book1. B.K. Hodge, “Analysis and Design of Energy Systems”, Prentice-Hall Inc., 1990
3. Online resources1. <https://nptel.ac.in/courses> (Design of Thermal System - Video course)



R.K.D.F. UNIVERSITY, BHOPAL
B.Tech. (Mechanical Engineering)
New Scheme Based On AICTE Flexible Curricula

FOURTH YEAR-Semester-VIII
Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
ME	MAJOR PROJECT-II	ME - 8051	0L-0T-8P	8

Course Outcomes: After studying this course, students will be able to,

1. Identify, analyze & define the problem.
2. Generate alternative solutions to the problem identified.
3. Compare & select feasible solutions from alternatives generated.
4. Design, develop, manufacture & operate equipment/program.
5. Acquire higher-level technical knowledge by studying recent development in Engineering field.
6. Compare machines/devices/apparatus for performance practices.
7. Work effectively in a team.

Contents (Theory)

Students shall be encouraged to form groups (Maximum 5) to do a Minor Project on technical topic of concern branch. The student should prepare a working system or some design or understanding of a complex system that he has selected for his project work using system analysis tools and submit the same in the form of a write-up i.e. detail project report. The student should maintain proper documentation of different stages of project such as need analysis, market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan wherever applicable. Each group of students is required to prepare a project report based on the above points and present the same at the final examination with a demonstration of the working system. Evaluation will be based on his performance in technical work pertaining to the solution of a small size problem, project report, and presentation of work and defending it in a viva-voce.

Text Book/References Books/ Websites: Nil

Suggested List of Laboratory Experiments :- (Expandable): Nil