Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Government of Maharashtra Act No. XXIX of 2014)
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Course Structure

for

M.Tech. in CAD/CAM

From 1st Semester- 4th Semester

(Only for Affiliated Institutes)

Vision

The vision of the Department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.

Mission

Imparting quality education, looking after holistic development of students and conducting need-based research and extension activities.

Programme Educational Objectives (PEOs)

No.	PEO
PEO1	To train the students with in-depth and advanced knowledge to become professional and capable of identifying, analyzing and solving complex problems in the areas of the CAD / CAM engineering.
PEO2	To enable post graduates to carry out innovative and independent research work, disseminate the knowledge in Academia/Industry/Research Organizations to develop systems and processes in the related field.
PEO3	To prepare the students to exhibit a high level of professionalism, integrity, effective communication skills and environmental and social responsibility.
PEO4	To provide an academic environment that gives adequate opportunity to the students to cultivate life-long independent learning ability for their successful professional career.

Programme Outcomes (POs)

At the end of the program, the students will be able to:

No.	PO
PO1	Acquire, demonstrate and apply advanced knowledge in the area of manufacturing engineering.
PO2	Identify problems in the field of manufacturing engineering, formulate them and solve by using advanced techniques.
PO3	Conduct independent research and generate new knowledge for the benefit of community, society Industry and country.
PO4	Apply various numerical methods, advanced software and engineering tools to model, analyze and solve manufacturing engineering problems.
PO5	Work effectively in interdisciplinary teams for solving real life problems in the related field.
PO6	Apply engineering and scientific principles for the effective management of manufacturing systems.
PO7	Effectively communicate through technical reports, presentations and scientific publications with the engineering community as well as society at large.
PO8	Demonstrate traits of management in handling engineering projects, related finance, and coordinate with workforce towards achieving goals.
PO9	Demonstrate high level of professional and intellectual integrity, ethics of research and scholarly standards.
PO10	Examine critically the outcomes of one's actions and make corrective measures subsequently.
PO11	Demonstrate the ability to work in team in the laboratory in achieving multidisciplinary tasks required for the project.
PO12	Engage in life-long reflective and independent learning with high level of enthusiasm and commitment.

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Abbreviations

PEO: Program Educational Objectives
PO: Program Outcomes
CO: Course Outcomes
L: No. of Lecture hours (per week)
T: No. of Tutorial hours (per week)
P: No. of Practical hours (per week)
C: Total number of credits
PCC: Professional Core Course
OEC: Open Elective Course
PEC: Professional Elective Course
AC: Audit Course
AEC: Ability Enhancement Course
VEC: Vocational Education Course
IKS: Indian Knowledge Society
MDM: Multidisciplinary Minor

Master of Technology in
(CAD/CAM)
Syllabus with effect from AY 2024-25

Semester-I

Course Code	Type/ Category of Course	Name of the Course	Hours/Week			Credit	Examination Scheme				
							Theory		CA	PR/OR	Total
			L	T	P		ESE	MSE			
	PCC	Computer Aided Design	3	1	--	4	60	20	20	--	100
	PCC	Computer Aided Manufacturing	3	1	--	4	60	20	20	--	100
	PCC	Computer Integrated Manufacturing	3	1	--	4	60	20	20	--	100
	PEC- I	A. Computational Fluid Dynamics	3	--	--	3	60	20	20	--	100
		B. Instrumentation and Automatic Control									
		C. Robotics									
	PEC- II	A. Failure Analysis and Design	3	--	--	3	60	20	20	--	100
		B. Machine Tool Design									
		C. Engineering Computing									
	OEC	A. Reverse Engineering	3	--	--	3	60	20	20	--	100
		B Research Methodology and IPR									
		C. Understanding Incubation and Entrepreneurship									
	PCC	Computer Aided Design and Manufacturing Laboratory	2	--	2	1	--	--	60	40	100
	AC	A. Universal Human Values & Professional Ethics	2			Audit		20	20	--	40
		B. Plastic Waste Management									
Total			**21**	**3**	**2**	**22**	**360**	**140**	**200**	**40**	**740**

Semester-II

Course Code	Type/ Category of Course	Name of the Course	Hours/Week			Credit	Examination Scheme				
							Theory		CA	PR/OR	Total
			L	T	P		ESE	MSE			
	PCC	Finite Element Method in Design	3	1	-	4	60	20	20	-	100
	PCC	Discrete Event Simulation	3	1	-	4	60	20	20	-	100
	PEC-III	A. Vehicle Dynamics B. Engg. Fracture Mechanics C. Noise Vibration and Harshness D. Design for Piping System E. Solid Free form Manufacturing F. Non – Destructive Testing G. Supply Chain Management	3	--	--	3	60	20	20	-	100
	PEC-IV	A Integrated Product Development B. Mechatronics C. Design for Mfg and Assembly D. Product Life cycle Management E. Designing with Advanced Materials F. Electronics Manufacturing Technology G. Optimization in Design H. Industry 4.0	3	--	--	3	60	20	20	--	100
	OEC-I	B. Design of Experiments C. Reliability in Engineering Systems D. Python and data science E. Design for Sustainability F. Engineering Economic Analysis	3	--	-	3	60	20	20	--	100
	AEC/VEC/ IKS	A. Indian Knowledge System: Concepts &Applications in Engineering B. Indian Knowledge System: Humanities & Social Sciences C. Ancient Indian Management	2	--	--	2	60	20	20		100
	AC	Research Paper Writing	2	--	--	Audit		20	20	--	40
	PCC	Technical Seminar	--	--	2	1	--	--	50	50	100
	PCC	Mini Project	--	--	2	1	--	--	50	50	100
		Total	**19**	**2**	**4**	**21**	**360**	**140**	**240**	**100**	**840**

Semester-III

Course Code	Type/ Category of Course	Name of the Course	Hours/Week			Credit	Examination Scheme				
							Theory		CA	PR/OR	Total
			L	T	P		ESE	MSE			
	OEC-II	A. Project Management for Managers	3	-	-	3	60	20	20	---	100
		B. Industrial Safety Engineering									
		C. Introduction to Machine Learning									
	MDM	A. Computer Control in Process Planning	3	--	--	3	60	20	20	--	100
		B. e-Commerce Technologies									
		C. Entrepreneurship & Start-ups									
	PC	Intellectual Property Rights	3	--	--	3	60	20	20		100
	PCC	Project Stage -I	-	-	--	10	--	--	50	50	100
Total			**9**	**-**	**--**	**19**	**180**	**60**	**110**	**50**	**400**

Semester-IV

Course Code	Type of Course	Name of the Course	Hours/Week			Credit	Examination Scheme				
							Theory				
			L	T	P		ESE	MSE	CA	PR/OR	Total
	PCC	Project Stage -II	---	--	--	20	--	--	100	100	200
		Total	**---**	**--**	**--**	**20**	**--**	**--**	**100**	**100**	**200**

Computer Aided Design

23UD2608PC101	Computer Aided Design	PCC	3-1-0	4 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Mechanics of Materials, Machine Design
Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT – 1 INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS

Overview of Graphics systems: Video Display Devices, Raster-Scan System, Random-Scan Systems, Graphics Monitors and Workstations, Input Devices, Hard-Copy Devices, Graphics Software.

Output primitives: Line Drawing Algorithm - DDA, Bresenham's and Parallel Line Algorithm. Circle generating algorithm – Midpoint Circle Algorithm.

Geometric Transformations: Coordinate Transformations, Windowing and Clipping, 2D Geometric transformations-Translation, Scaling, Shearing, Rotation and Reflection, Composite transformation, 3D transformations.

UNIT –2 CURVES AND SURFACES MODELLING

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubicspline- Bezier curve and B-Spline curve – curve manipulations.

Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermitebicubic surface- Bezier surface and B-Spline surface- surface manipulations.

UNIT – 3 NURBS AND SOLID MODELING

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations - constructive solid Geometry - comparison of representations - user interface for solid modeling.

UNIT – 4 VISUAL REALISM

Hidden Line removal, Hidden Surface removal, – Hidden Solid Removal algorithms - Shading –Coloring. Animation - Conventional, Computer animation, Engineering animation - types and techniques.

UNIT – 5 ASSEMBLY OF PARTS AND PRODUCT LIFE CYCLEMANAGEMENT

Assembly modeling — Design for manufacture — Design for assembly — computer aided DFMA - inferences of positions and orientation - tolerances analysis –Center of Gravity and mass property calculations - mechanism simulation. Graphics and computing standards - Data Exchange standards. Product development and management – new product development –models utilized in various phases of new product development – managing product life cycle.

REFERENCES:

1. Boothroyd, G, "Assembly Automation and Product Design" Marcel Dekker, New York, 1997.
2. Chitale A.K and Gupta R.C " Product design and manufacturing " PHI learning privatelimited, 6th Edition, 2015.
3. David Rogers, James Alan Adams "Mathematical Elements for Computer Graphics"2nd Edition, Tata McGraw-Hill edition.2003
4. Donald D Hearn and M. Pauline Baker "Computer Graphics C Version", Prentice Hall, Inc.,2nd Edition, 1996.
5. Ibrahim Zeid, "Mastering CAD/CAM", McGraw Hill, 2nd Edition, 2006
6. William M Newman and Robert F.Sproull "Principles of Interactive Computer Graphics",McGraw Hill Book Co. 1stEdition, 2001.

Computer Aided Manufacturing

23UD2608PC102	Computer Aided Manufacturing	PCC	3-1-0	4 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Theory of Machines, Kinematics of Machinery
Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT– 1 CNC Technology

Numerical Control: Need, Advantages, Apllications, Limitations; NC, CNC, DNC technologies; NC Machine tools; NC controllers: Point to point, Streaight Line and continuous path;

UNIT– 2 NC Programming

NC Programming — Basics, Languages, N Code, G Code, M Code, Program structure, types of program manuscriots/formats, Canned Cycles for Turning, Canned Cycles for Drilling, NC Programms for various types of Drilling, tapping, turning, and milling operations, branching and subroutines, safety subroutines, Computer generated NC programs.

UNIT–3 APT Programming

Introduction to APT programming, Types of statements, Tool path generation, Intol/Outtol, Programms for various types of Drilling, tapping, turning, and milling operations, branching and subroutines, safety subroutines, Computer Assisted programs.

UNIT– 4 Free Form Machining

Introduction to free form surface machining, Tool path generation and trajectory lanning, C vecor generation, Tool path strategies, Tool orientation, Workpiece coordinate system, machine coordinate system.

UNIT– 5 Planning, Installation and maintatinance of CNC systems

Planning for implementation of CNC systems in manufacturing units, preparation for CNC implementation, Integration of CNC systems with other manufacturing facilities in the shopfloor, Installation of CNC system, Preventive Maintenance of CNC systems, utilization of CNC machines.

REFERENCES:

1. Catherine A. Ingle, "Reverse Engineering", Tata Mc Graw Hill Publication, 1994
2. David D. Bedworth, Mark R. Henderson, Philp M. Wolfe, "Computer Integrated Design andmanufacturing", Mc Graw Hill International series, 1991
3. Donald R. Honra, "Co-ordinate measurement and reverse Engineering, American GearManufacturers Association.
4. Ibrahim Zeid and R. Sivasubramanian, "CAD/CAM Theory and Practice", Revised First specialIndian Edition, Tata Mc Graw Hill Publication, 2007
5. Ibrahim Zeid, "Mastering CAD/CAM", special Indian Edition, Tata Mc Graw Hill Publication,2007
6. Linda Wills, "Reverse Engineering" Kluwer Academic Press, 1996

Computer Integrated Manufacturing

PECIII-03	Computer Integrated Manufacturing	PEC-III	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Explain the role of computer in manufacturing processes
CO2	Explain the analysis of transfer line and flow line
CO3	Explain the need and significance of transformation, scaling, rotation
CO4	Explain the importance of CAPP
CO5	Explain the IOT applications in manufacturing

Unit 1: Introduction to CIM, Computers and manufacturing systems, Computer numerical control, Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, computerized elements of a CIM system, CAD/CAM and CIM. Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in process,

Unit 2: Automated Production Lines and Assembly Systems: Fundamentals, system configurations, applications, automated flow lines, buffer storage, control of production line, analysis of transfer lines, analysis of flow lines without storage, partial automation, analysis of automated flow lines with storage buffer, fundamentals of automated assembly systems, numerical problems.

Unit 3: CAD and Computer Graphics Software: The design process, applications of computers in design, software configuration, functions of graphics package, constructing the geometry. Transformations: 2D transformations, translation, rotation and scaling, homogeneous transformation matrix, concatenation, numerical problems on transformations.

Computerized Manufacture Planning and Control System: Computer Aided Process Planning, Retrieval and Generative Systems, benefits of CAPP, Production Planning and Control Systems, typical activities of PPC System, computer integrated production management system, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control

Unit 4:. **Flexible Manufacturing Systems:** Fundamentals of Group Technology and Flexible

Manufacturing Systems, types of FMS, FMS components, Material handling and storage system, applications, benefits, computer control systems, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture.

Line Balancing: Line balancing algorithms, methods of line balancing, numerical problems on largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights method.

Unit 5: Robot Technology:

Robot anatomy, joints and links, common robot configurations, robot control systems, accuracy and repeatability, end effectors, sensors in robotics. Robot programming methods: on-line and off-line methods. Robot industrial applications: Material handling, processing and assembly and inspection.

Future of Automated Factory: Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation, supply chain optimization, supply-chain & logistics, cyber-physical manufacturing systems.

References:

1. Chang, T.C. and Wysk, R.A., 1997. Computer-aided manufacturing. Prentice Hall PTR.

2. Xu, X., 2009. Integrating Advanced Computer-Aided Design, Manufacturing, and Numerical Control. Information Science Reference.

3. Groover, M.P., 2007. Automation, production systems, and computer-integrated manufacturing. Prentice Hall Press.

4. Weatherall, A., 2013. Computer integrated manufacturing: from fundamentals to implementation. Butterworth-Heinemann..

5. "CAD/CAM" by Ibrahim Zeid, Tata McGraw Hill.

6. Industry 4.0: The Industrial Internet of Things, Apress, 2017, by Alasdair Gilchrist

Computational Fluid Dynamics

	Computational Fluid Dynamics	PEC	3-0-0	3 Credits
Exam Scheme				
Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

Objectives:

1. Students will be able to understand the basics of conservation laws and transport mechanisms of fluid dynamics and numerical methods used for obtaining solution and calculation of engineering-parameters in CFD.
2. Algebraic formulation: develop the ability to do discretization by finite volume method.
3. CFD development: develop programming skills by in-house code development for conduction, convection or fluid dynamics problems.
4. CFD application and analysis: Learn to apply the code on various problems in fluid dynamics and heat transfer; and analyse as well as discuss the results.

Course Outcomes:

CO1	Apply suitable discretization technique to governing equations and convert into algebraic equations
CO2	Analyze the problem in fluid mechanics and heat transfer and mathematically model it
CO3	Develop an algorithm to solve the governing equations in CFD.
CO4	Create geometric model for real life application in an engineering domain.
CO5	Able to solve the numerical based on Navier stokes.

Mapping of COs with POs:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Note: 1- Means least contribution, 2- Means medium contribution 3- Maximum contribution

Course Content

Unit 1 Introduction [6 Hrs]

Introduction to CFD: What is CFD?, Why to study CFD?, CFD analysis process: development, application and analysis. Essentials of Fluid-Mechanics and Heat-Transfer: Conservation and subsidiary laws, transport mechanisms, and differential formulation from the conservation laws, Brief introduction of ODE (IVP and BVP) and PDE, classification of PDE.

Unit 2 Essentials of Numerical Methods [6 Hrs]

Finite Difference Method (FDM), FDM based algebraic-formulation for 1D and 2D steady state heat conduction, iterative solution of system of linear algebraic equations, Initial and Boundary conditions, various methods to solve PDE

numerically along with their advantages and disadvantages.

Unit 3 Discretization Techniques: Finite Volume Method [6 Hrs]

Discretization Methods, Discretization procedure in Finite-volume framework. Approximation of Surface Integrals, Approximation of Volume Integrals, explicit based solution-methodology for 1D system, upwind schemes.

Unit 4 Computational Heat-Transfer on a Cartesian-Geometry [6 Hrs]

Applications of Finite Volume Methods: One-dimensional and two-dimensional steady and unsteady state diffusion equation, steady state one-dimensional convection and diffusion, stability analysis, explicit and implicit method based solution-methodology.

Unit 5 Numerical Solution to Navier – Stokes Equation [6 Hrs]

Finite Volume Method (FVM) based algebraic-formulation for convection-diffusion problems, assessment of the central differencing scheme. Pressure correction technique, staggered grids, SIMPLE algorithm.

Text Books:

1. J. D. Anderson, Computational Fluid Dynamics, McGraw Hill, 1995
2. A. Sharma, Introduction to Computational Fluid Dynamics, Athena Academic and John Wiley & Sons, UK, 2017.
3. A. W. Date Introduction to Computational Fluid Dynamics, Cambridge Univ. Press, USA, 2009.
4. Versteeg, H.K. and Malalasekera W. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Longman Scientific & Technical, Harlow, 1995.
5. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press, 2010.
6. S.V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, New York, 1980.
7. K. Muralidhar, and T. Sundarajan, (Editors) Computational Fluid Flow and Heat Transfer (2nd ed.), IIT Kanpur Series, Narosa Publishing House, New Delhi, 2003.
8. J.H. Ferziger, and M. Peric Computational Methods for Fluid Dynamics, Springer Verlag, Berlin, 2002.

Reference Books:

1. D.C. Wilcox, Turbulence modeling for CFD, DCW Industries, La Canada, CA, 3rd Ed., 2006.
2. C. Hirsch, Numerical Computation of Internal and External Flows - The Fundamentals of Computational Fluid Dynamics, Butterworth-Heinemann, 2007
3. G. Biswas and V. Eswaran, Turbulent Flows: Fundamentals, Experiments and Modeling, arosa Publishing House, 2002.

Instrumentation and Automatic Control

23UD2608PE104C	Instrumentation and Automatic Control	PEC - I	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1

Introduction to measurements for scientific and engineering application need and goal. Broadcategory of methods for measuring field and derived quantities

Unit 2

Principles of measurement, parameter estimation, regression analysis, correlations, errorestimation and data presentation, analysis of data

Unit 3

Measurement of field quantities, thermometry, heat flux measurement, measurement of force, pressure, flow rate, velocity, humidity, noise, vibration, measurement of the above by probeand non-instructive techniques

Unit 4

Measurement of derived quantities, torque, power, thermo physical properties, radiation and surface properties

Unit 5

Analytical methods and pollution monitoring, mass spectrometry, chromatography, spectroscopy

Unit 6

Basics of P, PI, PID controllers, pneumatic and hydraulic controllers, electronic controllers,applications to machine tools, furnaces, material handling etc

Texts/References

1. Doebelin E.O: Measurement Systems-Application and Design, McGraw Hill Publication Co.
2. Beckwith TG. N. Lewis Buck and Marangoni R.D: Mechanical Measurements,Narosa Publishing House, New Delhi
3. Liptak B.G. Instrument Engineers' Handbook
4. Bolton W, Mechatronics-Electronics Control Systems in Mechanical and ElectricalEngg.
5. Modern Electronic Instrumentation and Measurement Technique by A.D. Helfrickand W.D. Cooper
6. Johnson C.D., Process Control Instrumentation
7. J. P. Holman: Experimental Methods for Engineers, McGraw Hill InternationalEdition, Seventh Edition

Robotics

	Robotics	**PEC - I**	**3-0-0**	**3 Credits**

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

CO1	
CO2	Explain the need and significance of drives
CO3	Explain the need and significance of robotics in manufacturing
CO4	Develop an equations for motions
CO5	Explain the applications of robots

Unit 1: Introduction to robotics: brief history, types, classification and usage, Work volume, various parameters in selection of robots.

Unit 2: Drives for robotics: stepper motors, servo motors, synchronous motor, Hydraulic Drive, Pneumatic Drive, Hybrid Drive, Sensors for Robots, Grippers.

Unit 3: Kinematics of robot: direct and inverse kinematics problems and workspace, inverse kinematics solution for the general manipulator, redundant and over-constrained manipulators.

Unit 4: Velocity and static analysis of manipulators: Linear and angular velocity, Jacobian of manipulators, singularity, static analysis. Dynamics of manipulators: formulation of equations of motion, recursive dynamics, and generation of symbolic equations of motion by a computer simulations of robots using software and commercially available packages.

Unit 5: Planning and control: Trajectory planning, position control, force control, hybrid control Industrial and medical robotics: application in manufacturing processes, e.g.

casting, welding, painting, machining, heat treatment and nuclear power stations, etc; medical robots: image guided surgical robots, radiotherapy, cancer treatment, etc; Advanced topics in robotics: Modelling and control of flexible manipulators, wheeled mobile robots, bipeds, etc.

References:

1. S. K. Saha, ―Introduction to Robotics‖, Tata McGraw-Hill Publishing Company Ltd. (2008).

2 S. B. Niku, ―Introduction to Robotics–Analysis Systems, Applications‖, Pearson Education (2001).

3. . A. Ghosal, Robotics: ―Fundamental Concepts and Analysis‖, Oxford University Press (2008).

5. Pires, ―Industrial Robot Programming–Building Application for the Factories of the Future‖, Springer (2007).

Failure Analysis and Design

	Failure Analysis and Design	**PEC -II**	**3-0-0**	**3 Credits**

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1

THEORIES OF FAILURE: Maximum shear stress theory, Maximum normal stress theory, Maximum distortion energy theory, Maximum strain theory, Applicability of theories of failure.

Unit 2

FRACTURE: Type of fracture, Theoretical cohesive strength of metals, Griffith theory of brittle fracture, fracture single crystals, Metallographic aspects of fracture, Dislocation theories of brittle fracture, Ductile fracture, Notch effects, Fracture under combined stresses.

Unit 3

ELEMENTS OF FRACTURE MECHANICS: Strain- energy release rate, Stress intensity factor, Fracture toughness, Plane - strain toughness testing, Crack-opening displacement, J- Integral to solve energy of crack formation, R-curves, Toughness of material.

FATIGUE FAILURE: Stress cycle, S-N curve, Description of fatigue fractured parts, Phases of fatigue fracture, Fatigue crack propagation, Effects of metallurgical variables, Temperature, Stress concentration, Size and surface factors, Fatigue under combined stresses.

Unit 4

CREEP FAILURE: Creep curve, Structural changes and mechanisms during creep, Activation energy for steady-state creep, Fracture at elevated temperature.

BRITTLE FRACTURE: Transition temperature curves, Fracture analysis diagrams, Varioustypes of embitterment, Fracture under very rapid loading.

Unit 5

DUCTILE FRACTURE: Condition for necking, Dislocation and void formation activities,Types of fractured parts.

ASSESSMENT OF TYPES OF FRACTURES BY OBSERVATION: Comparison between different fractured parts undergoing various type of fracture.

Unit 6

DESIGN APPLICATION OF THE KNOWLEDGE OF FAILURE: Design considering fatigue-Geber's parabola, Soderberg equation, lubricating optimally to combat bearing failures. Selection of materials to prevent seizure, galling, etc. Wear reduction techniques, Fracture toughness consideration in design.

Texts/ References:

1. Madoyag, F., Metal Fatigue Design and Theory.
2. Sors, L., Fatigue Design of Machine Components, Pergamon Press.
3. Rolfe, S.T. and Barson, J.M., Fracture and Fatigue Control Structures, Prentice Hall.
4. Broek, D., Elementary Engineering Fracture Mechanics, Noordnoff.
5. Dieter, G.E., Mechanical Metallurgy, McGraw Hill Book Co., New Delhi.

Machine Tool Design

23UD2608PE105D	Machine Tool Design	PEC-II	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Machine Design

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1

Introduction to metal cutting machine tools- criteria for the selection of operating capacityand design parameters, kinematics of machine tools.

Unit 2

Basic principles of machine tool design, estimation of drive power, machine tool drives, electrical, mechanical, and fluid drives, stepped and step less speed arrangements and systems.

Unit 3

Design of machine tool spindles and bearings, design of power screws, design of slide ways,selective and pre-selective mechanisms.

Unit 4

Machine tool structures-beds, columns, tables and supports, stock feed mechanism, Measurement and control of machine tools, protective and safety devices, design of precision machine tools.

Unit 5

Micro-feeding mechanisms, concept of modular design and integration of SPM`s, Conceptsof aesthetic and ergonomics applied to machine tools.

Unit 6

Acceptance tests standardization of machine tools, machine tool conditioning, latest trends inmachine tool design, Introduction to CAD techniques.

Texts/References:

1. N. K.Mehta , Machine tool design, Tata Mcgraw-hill, New Delhi, 1989.
2. N.Acherkan, Machine tool design, Vol. 3 and 4, Mir publisher, Moscow, 1968.
3. A.Koenigsburger, Design principles of metal cutting machine tools, Pergamon press,1964.
4. C.M.T.I. Machine tool design course notes, C.M.T.I. Bangalore.
5. G.Sen andA.Bhattacharya , Principles of machine tools, Vol. 2, NCB, Calcutta, 1973.

Engineering Computing

23UD2608PE105F	Engineering Computing	PECII	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit1

Data Analysis and Curve Fitting: Errors in numerical calculations, Interpolation by central differences, sterling Bessel & Everett Formulae, Interpolation Formula for unequal Intervals, Spline Interpolation, Cubic Splines. Least square method for linear & non-linear functions, weighted least square methods.

Unit 2

Solution of Linear System of Equations: Gauss Elimination with Pivoting, LU Decomposition method, Iterative methods, Eigen vectors-Jacobi method, Jacob's method, Gauss Siedel method.

Unit 3

Solution of Ordinary Differential Equation, Numerical Differentiation & Integration: Differentiation by Finite Differences, Numerical Integration by Newton-Cotes formula & Gauss Quadrature. Picard's Method, Euler's & Modified Euler's Method, Runge-Kutta

Method (up to fourth order), Predictor-Corrector Methods, Milne Sompson, Adams Bashforth Moulten Methods.

Unit 4

Boundary value and Eigen value problems: Shooting method, finite difference method tosolve boundary value problems, Polynomial method, power method to solve Eigen value problems.

Unit 5

Solution of Partial differential equations: Finite difference method, solution of Laplace&Parabolic equations.

Unit 6

Mathematical Modeling of Physical Problems, modeling Concepts, Modeling of LinearDifferential Equations of Second order.

Texts / References:

1. Dr. B.S. Grewal, Numerical methods for science &Engg., Khanna publications.
2. M.K. Jain, Numerical methods for Scientific &Engg. Computation, New age international publication.
3. E. Balagurusamy, Numerical methods, Tata McGraw Hill Publications.
4. K. Atkinson and W. Han, Elementary Numerical Analysis, 3rd Edition, Wiley-India,2004.
5. J. D. Hoffman and Steven Frankel, Numerical Methods for Engineers and Scientists,2nd Edition, McGraw-Hill, 2001
6. S. D. Conte and Carl de Boor, Elementary Numerical Analysis - An AlgorithmicApproach, 3rd Edition, McGraw-Hill, 1980.
7. S. S. Shastry, Introductory methods of numerical analysis, Third edition, Prentice hallof India publications pvt. Ltd.
8. Swami, Saran Singh, Computer programming and numerical methods.

Reverse Engineering

23UD2612OE106A	Reverse Engineering	OEC	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None
Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Unit 1 Introduction to Reverse Engineering & Geometric Form

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

Unit 2 Material Characteristics, Part Durability And Life Limitation

Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure

Unit 3 Material Identification and Process Verification

Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.

Unit 4 Data Processing, Part Performance and System Compatibility

Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis — Data Conformity and Acceptance — Data Report — Performance Criteria — Methodology of Performance Evaluation – System Compatibility.

Unit 5 Acceptance, Legality and Industrial Applications of RE

Legality of Reverse Engineering – Patent – Copyrights –Trade Secret – Third-Party Materials — Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical DeviceIndustry.

REFERENCES

1. Co-ordinate Measurement and reverse engineering, Donald R. Honsa, ISBN 1555897,American Gear Manufacturers Association
2. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
3. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
4. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
5. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
6. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994

Research Methodology and IPR

	Research Methodology and IPR	OEC	3-0-0	3 Credits
Exam Scheme				
Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

Course Objectives: Objectives of this course are

1. To select and define appropriate research problem and parameters with appropriate methodology.
2. To understand statistical techniques for the specific perspective data in an appropriate manner.
3. To make predictions and decisions for the data set using open-source software.
4. To understand the mathematical modeling and its predicting capability.
5. To learn the various steps in research writing and publication process and To introduce fundamental aspects of Intellectual property rights

Course Outcomes:

At the end of the course, student should be able to:

CO1	Define a research problem and use appropriate research methodology
CO2	Examine data using different hypothesis tests and make conclusions about acceptance or rejection of sample data.
CO3	Analyze numerical data, using standard procedures of probability theory to predict the performance.
CO4	Develop a mathematical model and analyze the prediction capabilities
CO5	Write a research paper and research proposal.

Mapping of COs with POs:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Note: 1- Means least contribution, 2- Means medium contribution 3- Maximum contribution

Course Content

Unit 1

Research Problem and Research Design [6 Hrs]

Objectives, Motivation, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Criteria of Good Research Definition and Feasibility study of research problem, Sources of research problem, Meaning of Hypothesis, Characteristics of Hypothesis, Errors in selecting a research problem, Concept & need of research design

Unit 2

Applied Statistics [6 Hrs]

Measures of Variability: Standard Deviation, variance, Quartiles, Interquartile Range Inferential Statistics: Statistical Significance (p values), Pearson's r test, t- test, Chi square test,

Unit 3

Probability [6 Hrs]

Sampling, Types of Sampling, Probability Distribution: Binomial Distribution, Poisson Distribution, Normal Distribution, Case Study: Develop a model for Prediction and Decision Making for the data set using open-source software

Unit 4

Research Report writing and Publication [6 Hrs]

Research Report: Dissemination of research findings, outline and structure of research report, different steps and precautions while writing research report, methods and significance of referencing. Publishing Research work: Selection of suitable journal for publishing research work, Open access Vs Subscription Journals, identifying indexing of selected journals, Impact factor of the journal, structure of research paper, Check for plagiarism of the article, Research paper submission and review process.

Unit 5

Intellectual property Rights [6 Hrs]

Definition of IPR, Classification of IP, Patentable and non-patentable inventions, statutory exceptions, Persons entitled to apply for patents. Prior Art Search, Patentability Criteria, Patent Filing Procedure, Forms and Fees, Case Study of Patent, Copyright.

Textbooks:

1. C. R. Kothari, Research Methodology: Methods and Techniques, New Age International, 2nd Edition, 1985
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition.,2010.
3. Ramakrishna B and Anil Kumar H S., Fundamentals of IPR, Notion Press, 2016
4. Virendra Kumar Ahuja, IPR in India, LexisNexis Butterworths Wadhwa Nagpur, 2017

Reference Books:

1. Stuart Melville and Wayne Goddard, Research methodology: An Introduction for Science & Engineering Students
2. S.D. Sharma, Operational Research, Kadar Nath Ram Nath & Co.

Understanding Incubation and Entrepreneurship

23UD2612OE106C	**Understanding Incubation and Entrepreneurship**	**OEC**	**3-0-0**	**3 Credits**

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None
Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course contents:

Course Contents:

Unit 1

□ Introduction to Entrepreneurship, Hand holding for Entrepreneurship GDC start-up stories, What is Entrepreneurship GDC Program

Unit 2

□ Entrepreneurship Types, Team Building, Methodology for innovation, Innovation and Entrepreneurship, Solar Oven case-study Paradigm shift from Design to Entrepreneurship, team building, problem statement presentation, IDEAS program, From users to customers- solar oven case study, student projects- customers discovery

Unit 3

□ Health care and innovation, Bio-Med Innovation and Entrepreneurship, Mad Tech success story, The innovation process, Human centered innovation, creating human experience design, New-age Entrepreneurship, Humanizing technology, Business model canvas, Technology led Entrepreneurship, Introduction to SINE incubator, Lean model Canvas SINE, start up success story

Unit 4

□ Entrepreneurship as Academic Program - IITH case study, ITIC Incubator, Success stories of CHfE, Entrepreneurship – Plan to action, Creativity and Generating Product Ideas, From Idea to Proof of Concept, Network Entrepreneurship, From corporate to Entrepreneurship, Creative Ideation, Building proof of concept

Unit 5

□ Learning from examples Start-up PITCHES - Using Lean Canvas Model Part 1, Start up project presentation by students

TEXTS/REFERENCES:

1. Disciplined Entrepreneurship: 24 Steps to a Successful Startup by Bill Aulet

2. The Essence of Medical Device Innovation by B Ravi

3. The Fortune At Bottom of Pyramid: Eradicating Poverty Through Profits by C.K.Prahalad 4. Stay Hungry Stay Foolish by Rashmi Bansal

5. The Entrepreneurial Connection: East Meets West in the Silicon Valley by Gurmeet Naroola

6. Innovation By Design: Lessons from Post Box Design & Development by B. K. Chakravarthy, Janaki Krishnamoorthi

COMPUTER AIDED DESIGN AND MANUFACTURING LABORATORY

23UD2608PCL107	COMPUTER AIDED DESIGN AND MANUFACTURING LABORATORY	PCC	0-0-2	1 Credits
Continuous Assessment 25 Marks	PR/OR 25 Marks		Total 50 Marks	

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents

COMPUTER AIDED DESIGN LABORATORY

1. **CAD Introduction.**
2. **Sketcher**
3. **Solid modeling** – Extrude, Revolve, Sweep and variational sweep, Loft
4. **Surface modeling** – Extrude, Sweep, Trim and Mesh of curves, Freeform.
5. **Feature manipulation** – Copy, Edit, Pattern, Suppress, History operations etc.
6. **Assembly** - Constraints, Exploded Views, Interference check
7. **Drafting** - Layouts, Standard & Sectional Views, Detailing & Plotting.

Exercises in modeling and drafting of mechanical components-assembly using parametric and feature-based packages like PRO-E/SOLIDWORKS /CATIA/NX

COMPUTER AIDED MANUFACTURING LABORATORY

LIST OF EXPERIMENTS

1. Programming and simulation for various operations using canned cycle for CNC turning Centre.
2. Programming and simulation for machining of internal surfaces in CNC turning Centre
3. Programming and simulation for profile milling operations
4. Programming and simulation for circular and rectangular pocket milling

5. Programming and simulation using canned cycle for CNC Milling such as peck drilling andtapping cycle
6. CNC code generation using CAM software packages – Milling
7. CNC code generation using CAM software packages – Turning
8. Dimensional and geometric measurement of machined features using VMS and CMM
9. PLC ladder logic programming.
10. Robot programming for Material handling applications.
11. Study on RDBMS and its application in problems like inventory control MRP.
12. Design and fabrication of a component using extrusion based additive manufacturing.

Note: Minimum 4 experiments to be performed from COMPUTER AIDED DESIGN LABORATORY and 6 experiments from COMPUTER AIDED MANUFACTURING LABORATORY

23UD2914AU108A: Universal Human Values & Professional Ethics

MAU18-A	**Universal Human Values & Professional Ethics**	**AU**	**2-0-0**	**Audit Course**

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam --	Total 40 Marks

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Contents

Unit 1: Need, basic guidelines, contents and process for value education

- Understanding the need
- basic guidelines
- content and process for Value Education
- Self-Exploration-what is it? – its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self- exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding
- Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
- Method to fulfil the above human aspirations: understanding & living in harmony at various levels.

Unit 2: Understanding harmony in human being- harmony in myself YSELF

- The understanding human being as a co-existence of the sentient 'T' and the material 'Body
- Understanding the needs of Self ('T') and 'Body' – Sukh and Suvidha
- Understanding the Body as an instrument of 'T' (I being the doer, seer, and enjoyer)
- Understanding the characteristics and activities of 'T' and harmony in T

- Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs
- meaning of Prosperity in detail
- Programs to ensure Sanyam & Swasthya.

Unit 3: Understanding harmony in family and society - harmony in human relationship.

Understanding harmony in the Family- the basic unit of human interaction.

- Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay tripti; Trust (Vishwas) and Respect (Samman) as the foundational vales of relationship.
- Understanding the meaning of Vishwas; Difference between intention and competence.
- Understanding the meaning of Samman.
- Difference between respect and differentiation; the other salient values in relationship.
- Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals.
- Visualizing a universal harmonious order in society.
- Undivided Society (Akhand Samaj).
- Universal Order (Sarvabhaum Vyawastha) – from family to world family.

Unit 4: Understanding harmony in the nature and in existence DERSTAINY

- Understanding the harmony in the Nature.
- Interconnectedness and mutual fulfilment among the four orders of nature – recyclability and self-regulation in nature.
- Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space.
- Holistic perception of harmony at all levels of existence.

Unit 5: Implications of the above holistic understanding harmony on professional ethics,

- Natural acceptance of human values
- The definitiveness of Ethical Human Conduct,
- The basis for Humanistic Education,
- Humanistic Constitution and Humanistic Universal Order,
- Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the

scope and characteristics of people-friendly and eco-friendly production systems,

- Technologies and management models,
- Case studies of typical holistic technologies,
- Management models and production systems,
- Strategy for the transition from the present state to Universal Human Order: a) At the level of the individual: as socially and ecologically responsible engineers,
- Technologists and Managers, b) At the level of society: as mutually enriching institutions and organizations.

Textbooks/Reference Books:

1. A Foundation Course in Human Values and Professional Ethics, R. R. Gaur, R. Asthana, G. P. Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019, ISBN 978-93-87034-47-1
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R. R. Gaur, R. Asthana, G. P. Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019, ISBN 97893- 87034- 53-2

Plastic Waste Management

23UD2608AU108B	Plastic Waste Management	AC	2-0-0	Audit Course

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam: --	Total 40 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1

□ Plastic and plastic types, uses of plastics, global statistics, plastic waste sources. Plastic waste sources production, Global sources of plastic waste and national sources of plastic waste

Unit 2

□ Plastic waste management rules 2016, Global rules and regulations, plastic bans including china sword policy implication on plastic global waste management, Plastic bans- global examples, plastic bans- china sword policy imparts, impact on global plastic waste management

Unit 3

□ Impact of plastic pollution on marine life, plastic pollution impact on marine and wildlife, health and environmental impact of plastic pollution

Unit 4

□ Plastic waste management practices- recycling and waste plastic, Mechanical and feedstock recycling, pyrolysis and waste to energy, landfilling, other applications, use of waste plastic in road construction.

Unit 5

□ Possible alternate materials to plastics – Greener alternatives, Biodegradable plastics, Greener plastic products, Biobased plastic products, How to quantify something is green, plastic resource recovery and circular economy, plastics and circular economy – case studies.

TEXTS/REFERENCES:

1. Plastic Waste Management by Murali Srinivasan and Natamai Subramaniam
2. The Circular Economy A User's Guide by Walter R Stahel. CRC Press 2019.
3. Waste to Wealth: The Circular Economy Advantage Peter Lacy, Jakob Rutqvist, 2015
4. Sustainable Practices for Landfill Design and Operation,Townsend, T.G., Powell, J., Jain, P., Xu, Q., Tolaymat, T., and Reinhart, D. (2015), Springer, USA
5. Recycling and recovery of plastics, Hanser Publishers, New York, 1996-R. Johanner Brandrup
6. Plastics Waste Management, Disposal Recycling and reuse, Marcel Dekker, Inc.New York,1993-Nabil Mustafa
7. Plastics and the Environment, Wiley Inter Science, New York (2003) – Anthony L.Andrady (Ed)
8. Plastics Recycling, Products and Processes, Hanser Publishers, New York,1992 –R.J. Ehrig.

Semester II

Finite Element Methods in Design

23UD2608PC201	**Finite Element Methods in Design**	**PCC**	**3-1-0**	**4 Credits**

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites:

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Unit 1

1-D PROBLEMS: Principles of linear elastic mechanics, principles of virtual displacements and minimum potential energy, Rayleigh Ritz method, exact v/s approximate solution, beam elements.

Unit 2

2-D PROBLEMS: Plane stress and plane strain conditions, triangular elements, constant straintriangle, linear strain triangle, Boundary conditions, body forces and stress recovery, quadrilateral elements.

Unit 3

2-D PROBLEMS: Lagrange and Serendipity shape functions, isoparametric formulation, numerical integration, modeling with isoparametric elements, requirements for convergence, patch test, nonconforming elements, reduced integration.

Unit 4

3-D PROBLEMS: Axisymmetric solids, governing equations, axisymmetric elements and their applications, mixed formulations, bending of flat plates (Kirchhoff Theory), continuity requirements and boundary conditions.

Unit 5

3-D PROBLEMS: Discrete Kirchhoff's elements, thick plate elements, plate bending applications, shells as assemblage of flat plates, finite element formulation for dynamic problems, mass properties, introduction to elastic stability for frames and plates.

Texts / References:

1. R. D. Cook, Concepts and Applications of Finite Element Analysis, John Wiley andSons, second edition, 1981.
2. C.S. Krishnamurti, Finite element method, Tata Mc-Graw Hill Publication.
3. K.J. Bathe, Finite Element Method and Procedures, Prentice hall, 1996.
4. Tirupathi, R., and Chandrupatla, Finite Elements in Engineering, PHI Publication, NewDelhi.
5. Bruce Irons and SoharabAhmed, Techniques of Finite Elements, John Wiley and Sons,New York.
6. K.J. Bathe, Finite Element Method, Prentice Hall, 1987.
7. O.P., Gupta, Finite and Boundary Element Methods in Engineering, Oxford and IBH.

Discrete Event Simulation

	Discrete Event Simulation	**PCC**	**3-1-0**	**4 Credits**

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1: Introduction to Simulation

Introduction to Simulation, Concept of system, model and simulation, Components of discrete event simulation Advantages and disadvantages of simulation, Statistical models in simulation, Probability distribution functions, Estimation of statistical parameters

Unit 2: Random Numbers and model setup

Generation of Random number and Random number Variates , Testing of random numbers, Input modeling: Estimation of parameters, Fit tests of distributions

Unit 3: Queing System

Characteristic of a queueing system, Simulation of single server queueing system, Output data analysis for single system: Statistical analysis for terminating and non terminating simulations, Comparing alternative system configurations

Unit 4: Verification of the simulation systems

Verification, validation and credibility of simulation models, Simulation of manufacturing and material handling

systems

Unit 5: Monte Carlo simulation case studies, Inventory Management using simulation

Refernce Book:

- A. M. Law and W. D. Kelton (2000), Simulation Modeling and Analysis, 3rd Ed., McGraw Hill International - Industrial Engg. Series.
- J. Banks, J. S. Carson, B. L. Nelson and D. M. Nicol (2001), Discrete Event System Simulation, 3rd Ed., Pearson Education International Series.
- W. D. Kelton, R. P. Sadowski and D. A. Sadowski (1998), Simulation with Arena, McGraw Hill International-Industrial Engg. Series.
- Y. Langsam, M. J. Augenstein and A. M. Tenenbaum (1998), Data Structures Using C and C++, 2nd Ed., Prentice Hall (India).
- K. S. Trivedi (2001), Probability and Statistics with Reliability, Queuing and Computer Science Applications, Eastern Economy Edition, Prentice-Hall (India).

NPTEL : Modeling and Simulation of Discrete Event Systems
By Dr. Pradeep K Jha, IIT Roorki

Vehicle Dynamics

23UD2608PE203A	Vehicle Dynamics	PEC-III	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1

INTRODUCTION TO VEHICLE DYNAMICS

Unit 2

LONGITUDINAL DYNAMICS: Vehicle Load Distribution – Acceleration and Braking - Brake Force Distribution, Braking Efficiency and Braking Distance - Longitudinal dynamicsof a Tractor-Semi Trailer

Unit3

TIRE MECHANICS – AN INTRODUCTION**:** Mechanical Properties of Rubber - Slip, Gripand Rolling Resistance – Tire Construction and Force Development- Contact Patch and Contact Pressure Distribution

Unit 4

A SIMPLE TIRE MODEL: Lateral Force Generation - Ply Steer and Conicity - Tire Models – Magic Formula Classification of Tire Models and Combined Slip

Unit 5

LATERAL DYNAMICS: Bicycle Model - Stability and Steering Conditions - Understeer Gradient and State Space Approach – Handling Response of a Vehicle -

Mimuro Plot for Lateral Transient Response - Parameters affecting vehicle handling characteristics

Unit 6

VERTICAL DYNAMICS**:** Rollover Prevention - Half Car Model - Quarter Car Model

Texts/References:

1. Pacejka, Hans. Tire and vehicle dynamics. Elsevier, 2005.
2. Wong, Jo Yung. Theory of ground vehicles. John Wiley & Sons, 2001.
3. Moore, Desmond F. "The friction of pneumatic tyres." (1975).
4. Jazar, Reza N. Vehicle dynamics: theory and application. Springer, 2008
5. Gillespie, Thomas D. Fundamentals of vehicle dynamics, 1992

Engineering Fracture Mechanics

23UD2608PE203B	**Engineering Fracture Mechanics**	**PEC-III**	**3-0-0**	**3 Credits**

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Basic Additive Manufacturing

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

Unit 1

INTRODUCTION: - Macroscopic failure mode, ideal fracture strength, energy release rate,Fracture Modes

Unit 2

FRACTURE CRITERIA: Griffith criterion, Irwin's Fracture Criterion, Stress Intensity Approach, Stress intensity factor, crack tip plasticity, crack opening displacement, plastic constraint

Unit 3

METHODS FOR EVALUATING FRACTURE TOUGHNESS:

Numerical Methods: - Finite Elements (FE), Finite Differences (FD), Boundary Integral Equations (BIE)
Experimental Methods: - Compliance Method, Photoelasticity. Interferometry and Holography

Unit 4

EXPERIMENTAL EVALUATION OF FRACTURE TOUGHNESS**:** Plane strain fracture toughness, J– Integral

Unit 5

FATIGUE MECHANICS**:** S-N diagram, fatigue limit, fatigue crack growth rate, Paris law.

Unit 6

CREEP MECHANICS**:** Creep deformation, creep strength, creep-fatigue interaction

Texts/References:

1. Fundamentals of Fracture Mechanics, T. Kundu, Pub. CRC Press (Taylor and Francis), 2008, ISBN 0-8493-8432-5
2. T. Anderson, Fracture Mechanics, CRC Pub.
3. D. Broek, Elementary Engineering Fracture Mechanics, 4th Revised Edition, KluwerAcademic Pub., 1991, ISBN 90-247-2656-5.
4. K. Hellan, Introduction to Fracture Mechanics, McGraw-Hill, 1984.
5. G. Sih, Handbook of Stress Intensity Factors.
1. 6 Timoshenko, S.P. and J.N. Goodier, "Theory of Elasticity", McGraw Hill (1970).
2. 7.Broek, D., "Elementary Engineering Fracture Mechanics", 4th edition, MartinusNijhoff(1987).
8. Rolfe, S.T. and J.M. Barsom, "Fracture and Fatigue Control in Structures, Applications of Fracture Mechanics", Prentice Hall (1977).
9. Hellan, K., "Introduction to Fracture Mechanics" McGraw-Hill (1985).
10. Maiti S. K., Fracture Mechanics: Fundamentals and Applications, Cambridge University Press, 2015.

Handbooks:

1. Tada, H., Paris, P. and Irwin, G., "The stress Analysis of Cracks Handbook" 3rd edition, ASME Pren (2000).
2. Rooke, D.P. and Cartwright, D.J., "Compedium of Stress Intensity Factors", HerMajestys Stationery Office, London (1976).
3. Murakami, Y. Editor in Chief, "Stress Intensity Factors Handbook", Pergamon Press(1988) (3 Volumes).

Noise, Vibration and Harshness

23UD2608PE203C	**Noise, Vibration and Harshness**	**PEC-III**	**3-0-0**	**3 Credits**

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1

NVH IN THE AUTOMOTIVE INDUSTRY: Sources of noise and vibration. Design features. Common problems. Marque values. Noise quality. Pass-by noise requirements. Target vehicles and objective targets. Development stages in a new vehicle programme and the altering role of NVH engineers.

Unit 2

SOUND AND VIBRATION THEORY: Sound measurement. Human sensitivity and weighting factors. Combining sound sources. Acoustical resonances. Properties of acoustic materials. Transient and steady state response of one degree of freedom system applied to vehicle systems. Transmissibility. Modes of vibration.

Unit 3

TEST FACILITIES AND INSTRUMENTATION: Laboratory simulation: rolling roads (dynamometers), road simulators, semi-anechoic rooms, wind tunnels, etc. Transducers, signal conditioning and recording systems. Binaural head recordings., Sound Intensity technique, Acoustic Holography, Statistical Energy Analysis

Unit 4

SIGNAL PROCESSING: Sampling, aliasing and resolution. Statistical analysis.

Frequency analysis. Campbell's plots, cascade diagrams, coherence and correlation functions.

Unit 5

NVH CONTROL STRATEGIES & COMFORT: Source ranking. Noise path analysis. Modal analysis. Design of Experiments and optimization of dynamic characteristics. Vibration absorbers and Helmholtz resonators. Active control techniques.

Unit 6

NVH LEGISLATIONS: Psycho-acoustics and effect of noise on human beings, Ambient airquality standards, Noise specifications for automotive vehicles – pass-by & stationary and Noise specifications for generator sets, fire crackers and household articles.

Texts/References:

1. Baxa, Noise Control of Internal Combustion Engine, John Wiley, 1984.
2. Ewins D. J., Model Testing: Theory and Practice, John Wiley,1995.
3. Boris and Kornev, Dynamic Vibration Absorbers, John Wiley, 1993.
4. McConnell K, "Vibration Testing Theory and Practice", John Wiley, 1995.
5. Legislation standard
6. Norton M P, Fundamental of Noise and Vibration, Cambridge University Press,1989
7. Munjal M.L., Acoustic Ducts and Mufflers, John Wiley, 1987
8. .

Design of Piping System

23UD2608PE203D	Design of Piping System	PEC-III	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Basic Electronics
Course Outcomes: At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Unit 1

PROCESS PIPING: Scope of Piping; Code and Standards; Mechanical Design Fundamentals; Mechanical design of piping system; Wall thickness; Piping size selection; Steel and cast iron pipe; Steel and wrought iron pipe; Light wall pipe; Tubing; Pipe connection and fittings; Rail fittings; Piping elements and specialties; Pipe representation; Welded and flanged fittings; Valves.

Unit 2

PIPING SYSTEM LAYOUT AND DESIGN: Piping layout; Equipment Layout; Process Piping Layout; Utility Piping Layout; Pipe flow sheets; Tube fastening and attachment; Non- ferrous tube fittings; Ducts and elbows; Pipe and tube design data; Design of steam piping; Design of oil piping; Design of cast iron pipe; Miscellaneous design and applications: Pipeline; Flexibility expansive forces in pipelines; Expansion stresses and reaction pipelines.

Unit 3

PIPE INSTALLATION: Selection of materials; Piping design; Basic principle; Piping sketches; Steam reducing and regulating valves; Selection of pipe size; Pipe hydraulics and

sizing; Flow of water in pipes; Economical pipe selection; Selection of steam pipe size; Determination of steam pipe size; Development of plot plan; Flexibility analysis.

Unit 4

PROCESS AUXILIARIES: Piping; Explanation of code; Methods of fabrication; Nominal pipe size; Non-metallic piping and tubing; Pipe sizing by internal diameter; Choosing the final pipesize; Process steam piping; Pressure relief system; Pressure relief devices; Design of pressure relief system; Layout by scale model method.

Unit 5

MECHANICAL PIPING DESIGN**:** Piping drawings; Piping stress design; Internal or external fluid pressure stresses; Design of overhead piping; Design of underground piping; Erection of piping and support; Insulation; Drainage piping design; Design of natural gas pipeline.

Unit 6

DESIGN OF PIPING SYSTEM FOR THE FOLLOWING APPLICATIONS: Refrigeration piping system, Cryogenic piping system, Transmission piping system, Steam power plant piping system, Underground steam-piping system, Underground petroleum piping, Submerged pipingfor petroleum products, Piping system sprinklers, Non-metallic piping; Selection and joining techniques; Cross Country Pipe Technology.

Texts/ References:

1. J. M. Coulson, R. K. Sinnott and J. F. Richerdson,'Chemical Engineering' vol.6,Maxwell McMillan International Edition.
2. Sabin Crocker, 'Piping Handbook' Fifth Edition, McGraw Hill Publication.
3. Sahu G. K. handbook of Piping Design, New Age International**,** 1998

Solid Freeform Manufacturing

23UD2608PE203E	Solid Freeform Manufacturing	PEC -III	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I INTRODUCTION

Need - Development of SFM systems – Hierarchical structure of SFM - SFM process chain – Classification – Applications. Case studies: Bio printing- Food Printing- Electronics printing – Rapid Tooling - Building printing. AM Supply chain. Economics aspect: Strategic aspect- Operative aspect.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING

Concepts and Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimization - Lightweight Structures - DFAM for Part Quality Improvement - CAD Modeling - Model Reconstruction - Data Processing for AM - Data Formats - Data Interfacing - Part Orientation - Support Structure Design and Support Structure Generation - Model Slicing - Tool Path Generation. Design Requirements of Additive Manufacturing: For Part Production, For Mass Production, For Series Production. Case Studies.

UNIT III VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES

Stereolithography Apparatus (SLA): Principles — Photo Polymerization of SL Resins - Pre Build Process – Part-Building and Post-Build Processes - Part Quality and Process Planning, Recoating Issues - Materials - Advantages - Limitations and Applications. Digital Light Processing (DLP) -Materials - Process - Advantages and Applications.

Laminated Object Manufacturing (LOM): Working Principles - Process - Materials, Advantages, Limitations and Applications. Ultrasonic Additive Manufacturing (UAM) - Process - Parameters - Applications. Case Studies.

UNIT IV MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES

Fused deposition Modeling (FDM): Working Principles - Process - Materials and Applications. Design Rules for FDM.

Selective Laser Sintering (SLS): Principles - Process - Indirect and Direct SLS - Powder Structure – Materials - Surface Deviation and Accuracy - Applications. Multijet Fusion.

Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Principles – Processes –Materials – Advantages - Limitations and Applications. Case Studies.

UNIT V JETTING AND DIRECT ENERGY DEPOSITION PROCESSES

Binder Jetting: Three dimensional Printing (3DP): Principles – Process - Physics of 3DP - Types of printing: Continuous mode — Drop on Demand mode - Process — Materials - Advantages - Limitations - Applications.

Material Jetting: Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limitations.

Laser Engineered Net Shaping (LENS): Processes- Materials- Advantages - Limitations and Applications. Case Studies.

REFERENCES:

1. Andreas Gebhardt and Jan-Steffen Hotter, “Additive Manufacturing:3D Printing for Prototyping and Manufacturing”, Hanser publications Munchen, Germany, 2016. ISBN:978-1-56990-582-1.
2. Ben Redwood, Brian Garret, FilemonSchöffer, and Tony Fadel, “The 3D Printing Handbook: Technologies, Design and Applications”, 3D Hubs B.V., Netherland, 2017. ISBN-13: 978-9082748505.
3. Ian Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing” Springer - New York, USA, 2nd Edition, 2015. ISBN- 13: 978-1493921126.
4. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 1st Edition, 2007 FL, USA. ISBN- 9780849334092.
5. Milan Brandt., “Laser Additive Manufacturing 1st Edition Materials, Design, Technologies, and Applications”, Woodhead Publishing, UK, 2016. ISBN- 9780081004333

NON-DESTRUCTIVE TESTING

23UD2608PE203F	NON-DESTRUCTIVE TESTING	PEC - III	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION &LIQUID PENETRANT TESTING

Introduction to various non-destructive methods, Comparison of Destructive and Non-destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.

Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications

UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques — High sensitivity techniques, Multi frequency, Phased array ECT, Applications.

Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications.

Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT IV ULTRASONIC TESTING

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B- Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

UNIT V RADIOGRAPHY

Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques — Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test.

Case studies on defects in cast, rolled, extruded, welded and heat-treated components - Comparison and selection of various NDT techniques

REFERENCES:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., “Practical Non Destructive Testing” Narosa publishing house, New Delhi, 2002
2. Krautkramer. J., “Ultra Sonic Testing of Materials”, 1st Edition, Springer – Verlag Publication, NewYork, 1996.
3. Peter J. Shull “Non-Destructive Evaluation: Theory, Techniques and Application” Marcel Dekker,Inc., New York, 2002
4. www.ndt.net

Supply Chain Management

23UD2608PE203G	Supply Chain Management	PEC - III	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit1

Introduction

Introduction, Generic Types of supply chain, Various Definitions and Implications, Major Drivers of Supply chain. Strategic Decisions- in Supply Chain Management Introduction, Business Strategy, Core Competencies in Supply Chain, Strategic SC Decisions, Customer Reletationship Management Strategy, Supplier Relationship Management Strategy Source of Management in Supply Chain Introduction, Elements of Strategic Sourcing, A Collaborative Perspective, Development of Partnership.

Unit 2

Inventory Management in Supply Chain

Introduction, Types of Inventory, Supply/ Demand Uncertainties, Inventory costs, Selective Inventory Control, Vendor Manage Inventory system, Inventory Performance Measure Logistics In Supply Chain Management Introduction, Strategy, Transportation Selection, Trade-off, Models for Transportation and Distribution, Third Party Logistics,, Overview of Indian Infrastructure for Transportation.

Unit 3
Information Technology in Supply Chain
Introduction, Types of IT Solutions like Electronic Data Inter change (EDI), Intranet/ Extranet, Data Mining/ Data Warehousing and Data Marts, E-Commerce, E- Procurement, Bar Coding Technology. Information System in Supply Chain Introduction, Computer Based Information Systems, Computer Models and Perceptions about ERP, ERP & SCM. Application of Mathematical Modeling in Supply Chain Introduction, Modeling, Consideration in Modeling SCM System, Structuring the Logistic chain, Concept of Modeling.

Unit 4
Reverse Supply Chain
Introduction, Reverse Supply Chain v/s Forward Supply Chain, Types of Reverse Flows, Issues in Management of Reverse Supply Chain, Reverse Supply Chain for Food items, Reverse Logistic and Environment Impact. Integration & Collaborative Supply Chain Introduction, Evolution of collaborative SCM, Efficient Customer response, Collaboration at various levels, Imperatives for Successful Integrative Supply Chains.

Unit 5
Agile Supply Chain Introduction, Source of Variability, Characteristics of Agile Supply Chain, Achieving Agility in Supply Chain. Cases of Supply Chain Cases of Supply Chain like, News Paper Supply Chain, Book Publishing, Mumbai Dabbawala, Disaster management, Organic Food, Fast Food.

TEXTS / REFERENCES:

1. Supply Chain Management Theories & Practices, R. P. Mohanty, S. G. Deshmukh, Dreamtech Press, 19-A, Anari Road, Daryaganj, New Delhi
2. Supply Chain Management Strategy, Planning & Operation by Sunil Chopra, Peter Meindl
3. Total Supply Chain Management by Ron Basu, J. Nevan Wright
4. Supply Chain Management, Chopra, Pearson
5. Logistics Engineering and Management, Blanchard, pearson

Integrated Product Development

23UD2608PC202	**Integrated Product Development**	**PCC**	**3-0-0**	**3 Credits**

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None
Course Outcomes: At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	

CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit– 1 Introduction To Product Design

Characteristics of Successful Product development –Duration and Cost of Product Development ― Challenges of Product Development - Product Development Processes and Organizations – Product Planning Process - Process of Identifying Customer Needs

Unit– 2 Product Specifications, Concept Generation,Selection And Testing

Establish Target and Final product specifications ― Activities of Concept Generation - Concept Screening and Scoring - Concept Testing Methodologies.

Unit–3 Product Architecture and Industrial Design

Product Architecture — Implications and establishing the architecture — Delayed Differentiation — Platform Planning — Related system level design issues - Need and impact of industrial design - Industrial design process - management of the industrial design process - assessing the quality of industrial design

Unit– 4 Design For Manufacture, Prototyping, and Robust Design

DFM Definition - Estimation of Manufacturing cost- Reducing the component costs, costs of supporting function and assembly costs – Impact of DFM decision on other factors - Prototype basics - Principles of prototyping — Prototyping technologies - Planning for prototypes - Robust design – Robust Design Process

Unit– 5 Product Development Economics and Managing Projects

Economic Analysis — Elements of Economic Analysis - Understanding and representing tasks- Baseline Project Planning - Accelerating the project - Project execution — Postmortem project evaluation.

REFERENCES:

1. Karl T.Ulrich, Steven D.Eppinger, Anita Goyal, "Product Design and Development", McGraw – HillEducation (India) Pvt. Ltd, 4th Edition, 2012.
2. Kenneth Crow, "Concurrent Engineering/Integrated Product Development". DRM Associates, 6/3,ViaOlivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book
3. Kevin N Otto, Kristin L Wood, “Product Design – Techniques in Reverse Engineering and NewProduct Development”, Pearson Education, Inc, 2016
4. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin Homewood, 1992
5. Stuart Pugh, "Total Design — Integrated Methods for successful Product Engineering", AddisonWesley Publishing, Neyourk, NY, 1991.

Biomaterials

23UD2608PE204A	Biomaterials	PEC-IV	3-0-0	3 Credits

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1

□ Introduction to Bio-Materials: Definition and classification of bio-materials, mechanical properties, surface and physical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena. Effects of physiological fluid on the properties of biomaterials.

Unit 2

□ Metallic implant materials: Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking. Host tissue reaction with bio metal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants, Vascular implants, Heart valve implants-Tailor made composite in medium.

Unit 3

□ Ceramic implant materials: Definition of bio ceramics. Common types of bioceramics: Aluminum oxides, Glass ceramics, Carbons. Bio resorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction).

Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

Unit 4

□ Polymeric Implant Materials: Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach, Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems. Synthetic polymeric membranes and their biological applications.

Unit 5

□ Testing of Biomaterials: Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilisation of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization, Tissue Replacement Implants: Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.

TEXTS/REFERENCES:

1. Sujata V. Bhatt, Biomaterials, Second Edition, Narosa Publishing House, 2005.

2. Sreeram Ramakrishna, Murugan Ramalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, Biomaterials: A Nano Approach, CRC Press, 2010.

3. Park J.B., "Biomaterials Science and Engineering", Plenum Press, 2015.

4. D F Williams, "Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume", VCH Publishers 1992.

5. Monika Saini, Yashpal Singh, PoojaArora, VipinArora, and KratiJain. "Implant biomaterials: A comprehensive review", World Journal of Clinical Cases, 2015.

6. John Enderle, Joseph D. Bronzino, Susan M.Blanchard, "Introduction to Biomedical Engineering", Elsevier, 2018.

Mechatronics

23UD2608PE204B	Mechatronics	PEC-IV	3-0-0	3 Credits

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Machining science

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

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

Unit 1

Introduction to Mechatronic systems, elements, advantages and practical examples of Mechatronic systems.

Sensors and Transducers:

Various types of sensors and transducers used in Mechatronic system such as pressure sensors, temperature sensors, velocity sensors, Acceleration sensors, proximity sensors, position sensors, force sensors, Optical encoders, Capacitive level sensor, tactile sensors, Selection of sensors.

Unit 2

Signal Conditioning and Data Representation: Types of electronic signals, need for signal processing, Operational amplifiers: Types, classification and applications, Opto-

isolators, Protection devices, Analogue to Digital and Digital to Analog Converters, interfacing devices, Electro-magnetic Relays, Data representation systems, Displays, seven segment displays, LCDdisplays, Printers, Data loggers, Data Acquisition Cards/Systems

Unit 3

Electrical Drives: Types of Electrical Motors, AC and DC motors, DC servomotors, Steppermotors, linear motors, etc.

Pneumatics and Hydraulics

Components of Pneumatic systems, actuators, direction control valves, pneumatic air preparation, FRL unit, methods of actuation of valves, Sequencing of Pneumatic cylinders using Cascade and shift register methods. Electro-pneumatic valves, Electro- pneumatic circuits using single and double solenoid methods. Hydraulic cylinders, design of cylinder, Design of Piston and piston rod, Valves, poppet valve, house pipes and design of tubing, Meter-in and Meter-out circuits.

Unit 4

Microprocessor and Microcontroller

8085 microprocessors, architecture, various types of registers and their functions in 8085µP, Instruction sets, interfacing, applications.8081 microcontroller, architecture, Instruction sets, various pins and their functions interfacing, applications.

Programmable Logic Controller

Introduction, Architecture, Types of inputs/outputs, Specifications, guidelines for Selection ofPLCs, Programming: Ladder logic and FBD

Unit 5

Control Systems

Open and closed loop system; block diagram manipulation/reduction, Transfer function,modeling of Mechanical Systems using spring, Dashpot and Masse quivalence.

Unit 6

Stability of Systems

On/Off controller, Proportional Control, Integral control, Derivative Control; PI, PD and PID Controllers, Introduction to control using state variable system models, Bode Plots and stability criteria.

Texts / References:

1. HMT Limited, Mechatronics, Tata McGraw-Hill, 1998.
2. Bolton, W., Mechatronics; Electronic Control Systemin Mechanical Engineering, PearsonEducationAsia,1999.
3. Raven, Automatic Control Engineering, McGraw Hill, NewYork,1986

Design for Manufacture & Assembly

23UD2608PE204C	Design for Manufacture & Assembly	PEC-IV	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit1

DESIGN FOR MANUFACTURING: reduce the cost of manufacturing process, understanding the process and constraints, standard components and process, consider the impact of DFM decisions and other factors.

Unit2

DESIGN CONSIDERATION IN METAL CASTING: Mold and Gating System Design, Directional Solidification, and Troubleshooting.

Unit 3

DESIGN FOR WELDING: selection of materials for joining, welding defects, minimize theresidual stresses etc. Design for forging and sheet metal and powder metal process.

Unit 4

SELECTION OF MATERIALS: choice of materials, organizing material and processes.

Unit 5

Application of Design for manufacture and assembly with selection of materials and ranking of processes like casting, injection moulding, sheet metal working, die casting, powder metal process, investment casting and hot forging,

Unit 6

Design for assembly and automation

Texts/References:

1. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacturing and Assembly, 2nd Edition
2. Harry Peck, "Design for Manufacture", Pittman Publication 1983.
3. 3.Robert Matousek, "Engineering Design – A systematic approach", Blackie & sonsLtd., 1963.
4. 4.James G. Bralla, "Hand Book of Product Design for Manufacturing", McGraw HillCo., 1986
5. 5.Swift K. G. "Knowledge based design for manufacture", Kogan Page Ltd., 1987.

Product Lifecycle Management

23UD2608PE204D	Product Lifecycle Management	PEC IV	3-0-0	3 Credits

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Course Outcomes: At the end of the course the student will

be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1 History, Concepts and Terminology Of PLM

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications.

Unit 2 PLM/PDM Functions and Features

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

Unit 3 Details of Modules In APDM/PLM Software

Case studies based on top few commercial PLM/PDM tools

Unit 4 Role of PLM In industries

Case studies on PLM selection and implementation (like auto, aero, electronic) other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for– business, organization, users, product or service, process performance.

UNIT 5 BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP.

REFERENCES

1. Antti Saaksvuori and Anselmi Immonen, "Product Lifecycle Management", SpringerPublisher, 2008 (3rd Edition).
2. International Journal of Product Lifecycle Management, Inderscience Publishers
3. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2003.
4. John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question", Springer Publisher, 2007.
5. John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011 (2nd Edition).
6. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2006.

Designing with Advanced Materials

23UD2608PE204E	**Designing with Advanced Materials**	**PEC IV**	**3-0-0**	**3 Credits**

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Engineering mathematics, Manufacturing Processes

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Unit 1 Introduction to Reverse Engineering & Geometric form

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

Unit 2 Material Characteristics, Part Durability and Life Limitation

Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure

Unit 3 Material Identification and Process Verification

Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.

Unit 4 Data Processing, Part Performance and System Compatibility

Statistical Analysis — Data Analysis — Reliability and the Theory of Interference — Weibull Analysis — Data Conformity and Acceptance — Data Report — Performance Criteria — Methodology of Performance Evaluation – System Compatibility.

Unit 5 Acceptance, Legality and Industrial Applications Of RE

Legality of Reverse Engineering – Patent – Copyrights –Trade Secret – Third-Party Materials –Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry.

REFERENCES:

1. George E.Dieter, Mechanical Metallurgy, McGraw Hill, 1988
2. Thomas H. Courtney, Mechanical Behavior of Materials, (2nd edition), McGraw Hill, 2000
3. Willam D. CallisterJr.and David G. Rethwisch, Callister's Materials Science and Engineering,(2nd edition)Wiley Editorial,2018
4. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., Selection and use of engineeringmaterials,(34d edition), Butterworth-Heiremann, 1997
5. Flinn, R.A., and Trojan, P.K., Engineering Materials and their Applications, (4th Edition)Jaico, 1999
6. Metals Hand book, Vol.10, Failure Analysis and Prevention, (10th Edition), Jaico, 1999
7. Ashby M.F., materials selection in Mechanical Design 2nd Edition, Butter worth 1999
8. www.astm.org/labs/pages/131350.htm

Electronics Manufacturing Technology

23UD2608PE204F	**Electronics Manufacturing Technology**	**PEC IV**	**3-0-0**	**3 Credits**

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT 1 INTRODUCTION TO ELECTRONICS MANUFACTURING

History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed Circuit Boards, types- single sided, double sided, multi layer and flexible printed circuit board, design, materials, manufacturing, inspection. Electronic packaging — Through Hole Technology (THT) and Surface Mount Technology (SMT)

UNIT 2 COMPONENTS AND PACKAGING

Through-hole components — axial, radial, multi leaded, odd form. Surface mount components- active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, Flipchip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.

UNIT 3 SOLDERING AND CLEANING

Soldering theory, effect of elemental constituents on wetting, microstructure and soldering, solder paste technology — fluxing reactions, flux chemistry, solder powder, solder paste composition and manufacturing, solder paste rheology, Wave soldering. Adhesive and solder paste application. solder system variables. soldering temperature profile. Reflow soldering - profile generation and control, soldering quality and defects. Post solder cleaning and selection. Measurement of cleanliness levels.

UNIT 4 SURFACE MOUNT TECHNOLOGY

SMT Equipment and Material Handling Systems, Handling of Components and Assemblies - Moisture Sensitivity and ESD, Safety and Precautions Needed, IPC and Other Standards, Stencil Printing Process, solder paste storage and handling, stencils and squeegees, process parameters, quality control - Component Placement, Equipment Type, Chip shooter, IC placer, Flexibility, Accuracy of Placement, Throughput, reflow soldering, adhesive, underfill and encapsulation process, applications, storage and handling, process & parameters.

UNIT 5 INSPECTION, TEST AND REWORK FOR PCB:

Inspection Techniques, Equipment and Principle — AOI, X-ray. stencil printing process- defects & corrective action, component placement process - defects & corrective action, Reflow Soldering Process- defects & corrective action, underfill and encapsulation Process- defects & corrective action, Testing of assemblies, In-circuit testing (ICT), functional testing, concept of yield, Rework and Repair, tools, rework criteria and process, Design for - Manufacturability, Assembly, Reworkability, Testing, Reliability and Environment.

REFERENCES

1. Coombs, Jr. C.E., " Printed Circuits Handbook " Mc Graw-Hill Hand books Sixth Edition, 2008
2. Gurnett, K.W., "Surface Mount Handbook", Newnes Elsevier , 1999
3. Landers, T.L., "Electronics Manufacturing Processes", Prentice Hall, 1998
4. Lee, N.C., "Reflow Soldering Process and Trouble Shooting – SMT, BGA, CSP and Flip ChipTechnologies", Newnes Elsevier, 2001
5. Prasad R.P., "Surface Mount Technology: Principles and Practice", New York: Chapman and Hall,1997.
6. Seraphim, D., Lasky, R.C. and Che-Yu Li, "Principles of Electronic Packaging" Mcgraw Hill, 1989.
7. Strauss, R.," SMT Soldering Handbook", Newnes Elsevier , 1998
8. Zant, P.V., " Microchip Fabrication – a practical guide to semiconductor processing "McGraw Hill,2000

Optimization in Design

23UD2608PE204G	Optimization in Design	PEC IV	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1

INTRODUCTION: Optimal problem formulation, engineering optimization problems, optimization algorithms. Single Variable Optimization Algorithms: Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient based methods, root finding using optimization techniques.

Unit 2

MULTIVARIABLE OPTIMIZATION ALGORITHMS: Optimality criteria, unidirectional search, direct search methods, gradient based methods, Computer programs on above methods.

Unit 3

CONSTRAINED OPTIMIZATION ALGORITHMS: Kuhn-Tucker conditions, transformation methods, sensitivity analysis, direct search for constrained minimization, linearized search techniques, feasible direction method, generalized reduced gradient method, gradient projection method, Computer programs on above methods.

Unit 4

SPECIAL OPTIMIZATION ALGORITHMS: Integer programming, Geometric programming, Genetic Algorithms, Simulated annealing, global optimization, Computer programs on above methods.

Unit 5

OPTIMIZATION IN OPERATIONS RESEARCH: Linear programming problem, simplex method, artificial variable techniques, dual phase method, sensitivity analysis

Unit 6

STOCHASTIC PROGRAMMING: Basic concepts of probability theory, random variables Distributions – mean, variance, Correlation, co-variance, joint probability distribution stochastic linear, dynamic programming.

Texts/References:

1. Deb Kalyanmoy, "Optimization in Engineering Design", PHI, New Delhi
2. Rao S. S. "Engineering Optimization", John Wiley, New Delhi.
3. Deb Kalyanmoy, "Multi-objective Algorithms using Evolutionary Algorithms", JohnWiley, New Delhi.
4. Paplambros P. Y. and Wilde D. J., "Principles of Optimum Design: Modeling andComputation", Cambridge University Press, UK
5. Chandrupatla, "Optimization in Design", PHI, New Delhi.

Industry 4.0

23UD2608PE204H	Industry 4.0	PEC-IV	3-0-0	3 Credits

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites:

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

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Course Contents:

UNIT 1

Introduction to Industry 4.0 The Various Industrial Revolutions - Digitalisation and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

UNIT 2

Road to Industry 4.0 - Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics

UNIT 3

System, Technologies for enabling Industry 4.0–Cyber Physical Systems - Robotic Automation and Collaborative Robots - Support System for Industry 4.0 - Mobile Computing - Cyber Security

UNIT 4

Role of data, information, knowledge and collaboration in future organizations - Resource- based view of a firm - Data as a new resource for organizations - Harnessing and sharing knowledge in organizations - Cloud Computing Basics -Cloud Computing and Industry 4.0

UNIT 5

Industry 4.0 IIoT case studies - Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world — Society 5.0

TEXT BOOKS

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things

Arsheep Bahga, Internet of Things: A Hands-On Approach

Research Methodology

23UD2608OE205A	Research Methodology	OEC-I	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Unit 1

Research Concepts – concepts – meaning – objectives – motivation. Types of research – descriptive research – conceptual research – theoretical research – applied research – experimental research.

Unit 2

Research process – Criteria for good research – Problems encountered by Indian researchers. Formulation of Research Task – Literature Review – Importance & Methods – Sources – Quantification of Cause Effect Relations – Discussions– Field Study – Critical Analysis of Facts Generated

Unit 3

Hypothetical proposals for future development and testing, selection of Research task.

Unit 4

Mathematical modelling and simulation – Concepts of modelling – Classification of mathematical models – Modelling with – Ordinary differential equations – Difference equations – Partial differential equations – Graphs – Simulation – Process of formulation of model based on simulation.

Unit 5

Interpretation and report writing – Techniques of interpretation – Precautions in interpretation – Significance of report writing – Different steps in report writing – Layout of research report – Mechanics of writing research report – Layout and format – Style of writing – Typing – References – Tables – Figures – Conclusion – Appendices.

Texts/References

1. J.W Bames, Statistical Analysis for Engineers and Scientists, McGraw Hill, N.York
2. Schank Fr., Theories of Engineering Experiments, Tata McGraw Hill Publication.
3. C. R. Kothari, Research Methodology, New Age Publishers.
4. Willktnsion K. L, Bhandarkar P. L, Formulation of Hypothesis, Himalaya Publication.

Design of Experiments

23UD2608OE205B	Design of Experiments	OEC-I	3-0-0	3 Credits

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Engineering mathematics-I

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1

Introduction: Modern quality control, quality in engineering design, history of quality engineering.

The Taguchi Approach to quality: Definition of quality, loss function, off-line and on-linequality control, Taguchi`s quality philosophy.

Unit 2

Full Factorial Designs: Experimentation as learning process, traditional scientific experiments, three factor design, replicating experiments, factor interactions, normal plots of estimated effects, mechanical plating experiments, two factor design, four factor design, Taguchi design and western design.

Unit 3

Fractional Factorial Design: Fractional factorial design based on eight run experiments, folding over an eight run experimental design, Fractional factorial design in sixteen run, folding over an sixteen run experimental design, blocking two level designs, other two leveldesigns.

Unit 4

Evaluating Variability: Necessity to analyze variability, measures of variability, the normal distribution, using two level designs to minimize variability, signal-to-noise ratio, minimizing variability and optimizing averages.

Taguchi Inner and Arrays: Noise factors, experimental designs for control and noise factors,examples.

Unit 5

Experimental Design for Factors at Three and Four level: Necessity to use more than two level, factors at four levels, factors at three levels. Analysis of Variance in Engineering Design: Hypothesis testing concepts, using estimated effects as test statistics, analysis of variance for two level designs, when to use analysis of variance.

Unit 6

Computer Software for Experimental Design: Role of computer software in experimental design, summery of statistical packages, example of use of software packages. Using

Experiments to improve Processes: Engineering design and quality improvement, steps to implementing use of engineering design.

Texts/References:

1. D.C. Montgomery, Design and Analysis of Experiments, 5th Edition, John Wiley andSons, NewYork, 2004.
2. R.H. Lochner and J.E. Matar, Designing for Quality: An Introduction to the Best of Taguchi and Western Methods of Statistical Experimental Design, Chapman and Hall, London, 1983.

Reliability in Engineering and Systems

23UD2608OE205C	Reliability in Engineering and Systems	OEC-I	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT– 1 RELIABILITY CONCEPT

Reliability definition – Quality and Reliability– Reliability mathematics – Reliability functions –Hazardrate–MeasuresofReliability–Designlife–Aprioriandposterioriprobabilities– Mortality of a component—Bath tub curve—Useful life.

UNIT– 2 FAILURE DATA ANALYSIS

Data collection –Empirical methods: Ungrouped/Grouped, Complete/Censored data – Time tofailure distributions: Exponential, Weibull– Hazard plotting– Goodness of fittest.

UNIT–3 RELIABILITYASSESSMENT

Different configurations–Redundancy–m/n system–Complex systems: RBD–Baye's method– Cut and tie sets—Fault Tree Analysis—Stand by system

UNIT–4 RELIABILITY MONITORING

Life testing methods: Failure terminated – Time terminated – Sequential Testing – Reliabilitygrowthmonitoring—Reliabilityallocation—Software reliability.

UNIT– 5 RELIABILITY IMPROVEMENT

Analysis of downtime – Repair time distribution – System MTTR – Maintainability prediction –Measures of maintainability—System Availability—Replacement theory.

REFERENCES:

1. Charles E.Ebeling,"An introduction to reliability and maintainability engineering",TMH,2000.
2. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems",Springer,2007.
3. Alessandro Birolini, Reliability Engineering: Theory and Practice 8th ed. 2017 Edition
4. Mohammad Modarres, Mark P. Kaminskiy, Vasiliy Krivtsov "Reliability Engineering and RiskAnalysis: A Practical Guide", Third Edition 3rd Edition

Python for Data Science

23UD2608OE205D	Python for Data Science	OEC-I	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites:

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Program Outcomes□ Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1:

Basics of Data Science and Python Spyder

Basics of data analysis and data modeling methodologies; and techniques for approaching data science, Spyder introduction, Setting working Directory, Creating and saving a script file, File execution, clearing console, removing variables from environment, clearing environment, Commenting script files, Variable creation, Arithmetic and logical operators, Data types and associated operations

Unit 2:

Python notebook using Google Colab; instructions using built-in Python data and control structures; random numbers within the random module; and basic plotting and data rendering

instructions using the matplotlib module, Sequence data types and associated operations: Strings, Lists, Arrays, Tuples, Dictionary, Sets, Range, instructions to create numpy arrays; instructions to index arrays using slicing; demonstrate computation and visualization using array operations; and instructions to load and save data using numpy file formats, random numbers within the numpy module; statistical methods within the scipy.stats module; and scipy.stats module for solving data science problems.

Unit 3:
•Pandas data frame and dataframe-related operations on Toyota Corolla dataset- Reading files, Exploratory data analysis, Data preparation and preprocessing, Data visualization on Toyoto Corolla dataset using matplotlib and seaborn libraries- Scatter plot, Line plot, Bar plot, Histogram, Box plot, Pair plot, Control structures using Toyota Corolla dataset- if-else family, for loop, for loop with if break, while loop, Functions, similarities and differences between data frames and arrays; instructions for cleaning data sets; implement operations on data frames; Python instructions for interacting with spreadsheet files; and built-in pandas visualization methods to visualize pandas data frame data.

Unit 4:
Seaborn commands to visualize pandas data frame data; advanced data visualization techniques; and seaborn module to solve data science problems, supervised learning techniques; scikit-learn module to supervised learning; Python scripts that extract features and reduce feature dimension; and models using data mining techniques.

Unit 5
Unsupervised learning concepts; scikit-learn module to perform unsupervised learning; similarities and differences between hierarchical clustering and K-means clustering; and validate models using clustering techniques, linear regression concepts; scikit-learn module to build linear regression models; scikit-learn module to validate linear regression models; and data overfitting, statsmodels module; autoregressive and moving average models; and AR, MA, and ARIMA models

Books and references

1. Introduction to linear algebra - Gilbert Strang
2. Applied statistics and probability for engineers –Douglas Montgomery
3. Mastering python for data science, Samir Madhavan
4. Python Data Analytics, With Pandas, NumPy, and Matplotlib, Fabio Nell, Apress publisher, 2018.

DESIGN FOR SUSTAINABILITY

23UD2608OE205E	DESIGN FOR SUSTAINABILITY	PCC	3-0-0	3 Credits

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT- 1 INTRODUCTION

Introduction - Economics of process selection - General design principles for manufacturability; Geometric Dimensioning & Tolerance (GD&T) – Form tolerancing: straightness, flatness, circularity, cylindricity – Profile tolerancing: profile of a line, and surface – Orientation tolerancing: angularity, perpendicularity, parallelism – Location tolerancing: position, concentricity, symmetry – run out tolerancing: circular and total–Supplementary symbols.

UNIT- 2 CAST & WELDED COMPONENTS DESIGN

Design considerations for: Sand cast – Die cast – Permanent mold parts. Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment. Resistance welding–Design considerations for: Spot–Seam–Projection–Flash & Upset weldment

UNIT- 3 FORMED & MACHINED COMPONENTS DESIGN

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts – Forged parts. Design considerations for: Turned parts– Drilled parts – Milled, planned, shaped and slotted parts–Ground parts.

UNIT- 4 DESIGN FOR ASSEMBLY

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly– Computer Application for DFMA.

UNIT- 5 DESIGN FOR ENVIRONMENT

Introduction– Environmental objectives–Global issues–Regional and local issues–Basic DFE methods–Design guide lines–Example application–Life cycle assessment–Basic method–AT&T's environmentally responsible product assessment-Weighted sum assessment method–Life cycle assessment method–Techniques to reduce environmental impact–Design to minimize material usage–Design for disassembly–Design for recyclability–Design for manufacture–Design for energy efficiency –Design to regulations and standards.

REFERENCES:

1. Boothroyd, G, 2nd Edition 2002, Design for Assembly Automation and Product Design. NewYork, Marcel Dekker.
2. Bralla, Design for Manufacture handbook, McGrawhill,1999
3. Boothroyd, G, Heartz and Nike, Product Design for Manufacture,MarcelDekker,1994
4. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher,USA,1995
5. Fixel, J. Design for the Environment McGraw Hill., 2nd Edition 2009
6. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub.,1996
7. Kevin Otto and Kristin Wood, Product Design. Pearson Publication,(Fourth Impression) 2009
8. Harry Peck, Designing for manufacture, Pitman–1973

Engineering Economic Analysis

23UD2608OE205F	Engineering Economic Analysis	OEC-I	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites:

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit-1: Introduction

Project Life Cycle Stages, What is a Feasibility Study?, Feasibility Study Process, What is Engineering Economic Analysis?, Engineering Economic Analysis Steps, Cost Terminologies.

Unit-2: Time Value of Money

Time Value of Money Concept, Cash Flow Diagrams, Interest and Interest Rate, Types of Interest Rates

Unit-3: Economic Equivalence

Economic Equivalence Concept, Uniform (Equal) Series Cash Flow, Uneven (Irregular) Series Cash Flow, Arithmetic (Linear) Gradient Series Cash Flow, Geometric Gradient Series Cash Flow, Composite Cash Flow

Unit-4: Money Management

Money Management Aspects, Multiple Compounding Periods Concept, Nominal and Effective Interest Rates, Changing Interest Rates, Amortized Loans, Add-On Loans, Inflation, Customized Loans

Unit-5: Measuring Worth Investments

Project Cash Flow, Measuring Worth of Investments Methods, Payback Period Method, Net Present Worth Method, Net Future Worth Method, Net Annual Worth Method, Internal Rate of Return (IRR) Method, IRR Direct Solution Method, IRR Trial and Error Method, External Rate of Return Method.

Types of Projects/Investments, Independent and Mutually Exclusive Projects, Ranking Approach, Time Span Equalizing.

Texts/References:

1. Engineering Economic Analysis, Donald G. Newman, Jerome P. Lavalle and Ted G. Eschenbach, Oxford University Press, 12th Edition.

Indian Knowledge System: Concepts and Applications in Engineering

23UD2612IK206A	Indian Knowledge System-Concepts and Applications in Engineering	**IKS**	**2-0-0**	**2 Credits**

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit-1

Indian Knowledge System – An Introduction: 1. What is IKS? 2. Why do we need IKS? 3. Organization of IKS 4. Historicity of IKS 5. Some salient aspects of IKS

The Vedic Corpus: 1. Introduction to Vedas 2. A synopsis of the four Vedas 3. Sub-classification of Vedas 4. Messages in Vedas 5. Introduction to Vedāṅgas 6. Prologue on Śikṣā and Vyākaraṇa 7. Basics of Nirukta and Chandas 8. Introduction to Kalpa and Jyotiṣa 9. Vedic Life: A Distinctive Features

Unit-2

Number Systems and Units of Measurement: 1. Number systems in India - Historical evidence 2. Salient aspects of Indian Mathematics 3. Bhūta-Saṃkhyā system 4. Kaṭapayādi system 5. Measurements for time, distance, and weight 6. Piṅgala and the Binary system

Mathematics: 1. Introduction to Indian Mathematics 2. Unique aspects of Indian

Mathematics 3. Indian Mathematicians and their Contributions 4. Algebra 5. Geometry 6. Trigonometry 7. Binary mathematics and combinatorial problems in Chandaḥ Śāstra 8. Magic squares in India

Astronomy: 1. Introduction to Indian astronomy 2. Indian contributions in astronomy 3. The celestial coordinate system 4. Elements of the Indian calendar 5. Notion of years and months 6. Pañcāṅga – The Indian calendar system 7. Astronomical Instruments (Yantras) 8. Jantar Mantar of Rājā Jai Singh Sawai.

Unit-3

Engineering and Technology: Metals and Metalworking: 1. Wootz Steel: The rise and fall of a great Indian technology 2. The Indian S & T heritage 3. Mining and ore extraction 4. Metals and metalworking technology 5. Iron and steel in India 6. Lost wax casting of idols and artefacts

7. Apparatuses used for extraction of metallic components

Engineering and Technology: Other applications: 1. Irrigation systems and practices in South India 2. Literary sources for science and technology 3. Physical structures in India 4. Irrigation and water management 5. Dyes and painting technology 6. The art of making perfumes 7. Surgical techniques 8. Shipbuilding 9. Sixty-four art forms (64 Kalās) 10. Status of Indigenous S & T.

Unit-4

Town Planning and Architecture: 1. Perspective of Arthaśāstra on town planning 2. Vāstu- śāstra – The science of architecture 3. Eight limbs of Vāstu 4. Town planning 5. Temples in India: marvelous stone architecture for eternity 6. Temple architecture in India 7. Iconography**.**

Knowledge Framework and classifications: 1. Indian scheme of knowledge 2. The knowledge triangle 3. Prameya – A vaiśeṣikan approach to physical reality 4. Dravyas – the constituents of the physical reality 5. Attributes – the properties of substances and Action – the driver of conjunction and disjunction 6. Sāmānya, viśēṣa, samavāya 7. Pramāṇa – the means of valid knowledge 8. Saṃśaya – ambiguities in existing knowledge 9. Framework for establishing valid knowledge 10. Deductive or inductive logic framework 11. Potential fallacies in the reasoning process 12. Siddhānta: established tenets in a field of study

Unit-5

Linguistics 1. Introduction to Linguistics 2. Aṣṭādhyāyī 3. Phonetics 4. Word generation 5. Computational aspects 6. Mnemonics 7. Recursive operations 8. Rule based operations 9. Sentence formation 10. Verbs and prefixes 11. Role of Sanskrit in natural language processing.

TEXTBOOKS /REFERENCES:

1. **Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022),** "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.

For additional reading:

1. Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
2. Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.

3. Bag, A.K. (1979). Mathematics in Ancient and Medieval India, Chaukhamba Orientalia, New Delhi.
4. Datta, B. and Singh, A.N. (1962). History of Hindu Mathematics: Parts I and II, Asia Publishing House, Mumbai.
5. Kak, S.C. (1987). "On Astronomy in Ancient India", Indian Journal of History of Science, 22(3), pp. 205–221.
6. Subbarayappa, B.V. and Sarma, K.V. (1985). Indian Astronomy: A Source Book, Nehru Centre, Mumbai.
7. Bag, A.K. (1997). History of Technology in India, Vol. I, Indian National Science Academy, New Delhi.
8. Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.
9. Banerjea, P. (1916). Public Administration in Ancient India, Macmillan, London.
10. Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.

Indian Knowledge System: Humanities and Social Sciences

23UD2612IK206B	Indian Knowledge System-Humanities and Social Sciences	**IKS**	**2-0-0**	**2 Credits**

1.

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam -- Marks	Total 40 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

2.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit-1

Indian Knowledge System – An Introduction: 1. What is IKS? 2. Why do we need IKS? 3. Organization of IKS 4. Historicity of IKS 5. Some salient aspects of IKS

The Vedic Corpus: 1. Introduction to Vedas 2. A synopsis of the four Vedas 3. Sub-classification of Vedas 4. Messages in Vedas 5. Introduction to Vedāṅgas 6. Prologue on Śikṣā and Vyākaraṇa 7. Basics of Nirukta and Chandas 8. Introduction to Kalpa and Jyotiṣa 9. Vedic Life: A Distinctive Features

Unit-2

Philosophical Systems: 1. An introduction to philosophical systems 2. Development of philosophy 3. Unique features of philosophy 4. Sāṅkhya approach of philosophy 5. Introduction to Yoga 6. Tenet of Nyāya philosophy 7. Principles of Vaiśeṣika 8.

Doctrine of Pūrva-Mīmāṃsā Darśana 9. Thesis of Vedānta and synopsis of Advaita 10. Philosophy of Viśiṣṭādvaita 11. Ideology of Dvaita 12. Tenets of Jaina 13. Doctrine of Buddhism 14. Notions of Cārvāka

Wisdom through the Ages: 1. Gateways of ancestral wisdoms 2. Introduction to Purāṇa 3. The Purāṇic repository 4. Issues of interest in Purāṇas 5. Introduction to Itihāsas 6. Key messages in Itihāsas 7. Wisdom through Nīti-śāstras 8. Wisdom through Subhāṣita

Unit-3

Knowledge Framework and classifications: 1. Indian scheme of knowledge 2. The knowledge triangle 3. Prameya – A vaiśeṣikan approach to physical reality 4. Dravyas – the constituents of the physical reality 5. Attributes – the properties of substances and Action – the driver of conjunction and disjunction 6. Sāmānya, viśēṣa, samavāya 7. Pramāṇa – the means of valid knowledge 8. Saṃśaya – ambiguities in existing knowledge 9. Framework for establishing valid knowledge 10. Deductive or inductive logic framework 11. Potential fallacies in the reasoning process 12. Siddhānta: established tenets in a field of study

Linguistics: 1. Introduction to Linguistics 2. Aṣṭādhyāyī 3. Phonetics 4. Word generation 5. Computational aspects 6. Mnemonics 7. Recursive operations 8. Rule based operations 9. Sentence formation 10. Verbs and prefixes 11. Role of Sanskrit in natural language processing

Unit-4

Number Systems and Units of Measurement: 1. Number systems in India – Historical evidence 2. Salient aspects of Indian Mathematics 3. Bhūta-Saṃkhyā system 4. Kaṭapayādi system 5. Measurements for time, distance, and weight 6. Piṅgala and the Binary system

Health Wellness and Psychology: 1. Introduction to health 2. Āyurveda: approach to health 3. Sapta-dhātavaḥ: seven-tissues 4. Role of agni in health 5. Tri-doṣas 6. Āyurveda: definition of health 7. Psychological aspects of health 8. Disease management elements 9. Dinacaryā: daily regimen for health & wellness 10. Importance of sleep 11. Food intake methods and drugs 12. Approach to lead a healthy life 13. Indian approach to psychology 14. The tri guṇa system & holistic picture of the individual 15. The Nature of Consciousness 16. Consciousness studies and issues

Unit-5

Town Planning and Architecture: 1. Perspective of Arthaśāstra on town planning 2. Vāstu-śāstra – The science of architecture 3. Eight limbs of Vāstu 4. Town planning 5. Temples in India: marvelous stone architecture for eternity 6. Temple architecture in India 7. Iconography

Governance and Public Administration: 1. Introduction to raja dharma 2. Arthaśāstra: a historical perspective 3. Elements of a kauṭilyan state 4. The king & the amātya 5. Janapada & durga 6. Treasury and the State Economy (Kośa) 7. Danda 8. Mitra 9. The Administrative Setup 10. Relevance of Arthaśāstra 11. Public Administration in Epics

TEXTBOOKS /REFERENCES:

1. **Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N.**

(2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.

Additional Readings:

1. Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
2. Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.
3. Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.
4. Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.
5. Dasgupta,S. (1975). A History of Indian Philosophy- Volume 1, Motilal Banarsidass, New Delhi.
6. PLofker, K. (1963). Mathematics in India, Princeton University Press, New Jeresy, USA"

Ancient Indian Management

23UD2612IK206C	Ancient Indian Management	IKS	2-0-0	2 Credits

1.

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam -- Marks	Total 40 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit-1

Introduction

Understanding management: Defining management, Nature of management, Management: Science or art?

Ancient Indian Management

Unit-2

Management Perspective of Ancient Indian Literature: What is Jain Literature?, What is Vedantic Literature?, code of conduct in vedantic literature, code of conduct in Jain Literature, Four pillars of human labor in ancient Vedantic and Jain Literature

Management lessons from Mahabharata

Unit-3

Management in Bhagavad Gita:

- Introduction to Gita**,**
- Management Lessons from Bhagavad Gita**,**

Unit-4

Management lessons from Ramayana:

- Introduction to Ramayana**,**
- Management Lessons from Ramayana

Unit-5

Ancient Indian Economics:

- Kautilya's economics
- Mahavira's economics

TEXTBOOKS / REFERENCES:

1. Indian Management by Subhash Sharma. New Age International (P) Limited Publishers< New Delhi ISBN: 978-93-89802-41-2
2. Management Concepts - In Ancient Indian Psycho-Philosophic Thought &Thier Significance for Present Day Organisations by Ipshita Bansal, Popular Book Depo
3. In Indian Logic: Modern Management Philosophies as derived from Ancient Indian Philosophies, by Aparna Singh.

Research Paper Writing

23UD2608VS207	Research Paper Writing	PCC	2-0-0	Audit Course

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End Sem Exam: --	Total 40 Marks

Pre-Requisites: Communication Skills

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

Unit 1

□ Types of Research

Role & purposes of Research Designs, Defining and differentiating research: Descriptive Research, Analytical Research, Applied Research, Fundamental Research, Quantitative Research, Qualitative Research, Conceptual Research, and Empirical Research

Unit 2

□ Sources of Information

Finding/Gathering information for research, using information, Using research tools, Using Library and electronic databases

Unit 3

□ Writing research literature review

Need for a literature review, Strategies for writing literature review, Reviewing skills, Literature search and evaluation, Method of conducting a literature review, Organizing the literature review

Unit 4

□ Citing sources/references and maintaining Academic honesty Referencing and in-text citations, Styles of referencing, Paraphrasing and summarizing, Citing sources, Developing academic honesty

Unit 5

□ Writing, refining and editing a research paper

Writing a Research Proposal, Developing objectives of the research topic, Developing logical research statements and hypotheses, Editing the research paper, Proofreading techniques, Revision of the research paper

Unit 6

□ Ethical issues in collecting data

Ethics, stakeholders in research, ethical issues concerning participants, seeking consent, providing incentives, confidentiality, bias, incorrect reporting, issues with sponsoring organizations, Study of research papers in the respective areas of specialization.

TEXTS/REFERENCES:

1. Kothari, C. R. (2004). Research Methodology: Methods and Techniques. New Delhi: New Age International.
2. Kumar, R. (2005). Research Methodology-A Step-by-Step Guide for. Singapore: Pearson Education.
3. Saravanavel, P. (2012). Research Methodology. Allahabad: Kitab Mahal Publishers. Page 3 of 3

Technical Seminar

23UD2608PC208	Seminar	PCC	0-0-2	1 Credit

Continuous Assessment 50 Marks	PR/OR 50 Marks	Total 100 Marks

Pre-Requisites: Previously studied courses.
Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Objective:
To assess the debating capability of the student to present a technical topic. Also, to impart training to a student to face audience and present ideas and thus creating self-esteem, self-confidence and courage that are essential for an engineer.

Individual students are required to choose a topic of their interest from Manufacturing Systems Management related topics preferably from outside the M.Tech syllabus or an extension of syllabus and give a seminar on that topic for about 30 minutes. The Seminar can also be a case study from a manufacturing organization. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Mini Project

23UD2608PC209	Mini Project	PCC	0-0-2	1 Credit

Continuous Assessment 50 Marks	PR/OR 50 Marks	Total 100 Marks

Pre-Requisites: Previously studied courses.

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Objectives:

To train students in identification, analysis, finding solutions and execution of live engineering and managerial problems. It is also aimed to enhance the capabilities of the students for group activities.

Individual students are required to choose a topic of their interest. The course content of the mini project shall be from emerging / thrust areas, topics of current relevance having research aspects or shall be based on industrial visits. Students can also choose live problems from manufacturing organisations as their mini project. At the end of the semester, the students should submit a report duly authenticated by the respective guide, to the head of the department.

Mini Project will have internal marks 50 and Semester-end examination marks 50.

Internal marks will be awarded by respective guides as per the stipulations given below.

Attendance, regularity of student (20 marks)

Individual evaluation through viva voce / test (30 marks)

Total (50 marks)

Semester end examination will be conducted by a committee consisting of three faculty members. The students are required to bring the report completed in all respects duly authenticated by the respective guide and head of the department, beforethe committee. Students individually will present their work before the committee. The committee will evaluate the students individually and marks shall be awarded as follows.

Report = 25 marks

Concept/knowledge in the topic = 15 marks, Presentation = 10 marks,

Total marks = 50 marks

Semester III

Project Management for Managers

23UD2608OE301A	Project Management for Managers	OEC-II	3-0-0	3 Credits

Continuous Assessment - 20 Marks	Mid Sem Exam - 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Engineering mathematics-I

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

Unit 1

□ Introduction to project management, project success, types of structure organizations, project management office, stake holders management, types of projects and project life cycle, project life cycle phases and project appraisal, methods of project selection –I, methods of project selection – II, MCDM-I, Methods of project selection MCDM- II, MCDM –III

Unit 2

□ Market and demand analysis – I, market and demand analysis – II, Financial analysis, capital budgeting techniques – I, capital budgeting techniques –II, Financing of projects, Risk management I and Risk management II, Risk management (Control and documentation), stand alone risk analysis I, stand alone risk analysis II, Hilier model.

Unit 3

□ Simulation analysis, decision tree analysis –I, decision tree analysis –II, Abandonment analysis, Technical analysis, product mix and plant capacity analysis, Project team building, conflict and negotiation, HRM Issues and time management.

Unit 4

□ Introduction to project time management, project scheduling, node numbering, PERT Networks, CPM, Laddering in PERT/CPM, probability models in networks-I, probability models in network –II,

Unit 5

□ Probability models in network –III and IV, simulations of networks I and II, Slacks and floats, time and cost relationship, crashing of networks, Free float method, Introduction to project crash management, cost control tools and techniques, cost estimation, introduction to quality management

TEXTS/REFERENCES:

1. "Project Management- A Managerial Approach", Jack Meredith, Samuel J. Mantel Jr.,

John Wiley and Sons

2. Project Management For Engineering, Business And Technology, John M. Nicholas (Author), Herman Steyn (Author), Routledge; 6th edition (August 3, 2020)

3. Engineering Project Management by Neil G. Siegel, Wiley 1st edition (February 18, 2020).

4. Project Management: The Managerial Process, 8th Edition, By Erik Larson and Clifford Gray, McGraw Hill

5. Mitra, Amitava. Fundamentals of Quality Control and Improvement, Wiley India Pvt Ltd.

6. Evans, J R and W M Lindsay, An Introduction to Six Sigma and Process Improvement, CENGAGE Learning.

Industrial Safety Engineering

23UD2608OE301B	Industrial Safety Engineering	OEC-II	3-0-0	3 Credits

Mid SemTest 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Engineering mathematics-I

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Unit-1

Introduction, key concepts, terminologies, safety domain ontology, and safety quantification, safety by design, Application of hazard identification techniques (e.g., HAZOP, FMEA, etc.) - preliminary hazard list, preliminary hazard analysis, Risk assessment and Control, Safety engineering and accident causing mechanism

Unit-2

Fault tree Analysis- construction, gate by gate method, cut set method, importance measures, and event tree analysis (qualitative & quantitative), Bow-tie tool, common cause cut sets, cut sets for accident scenarios, identification of safety barriers,

Unit-3

Risk assessment, Consequence assessment, Energy control model and hazard control hierarchy, Safety function deployment, Ranking of design solution using AHP, Safety vs reliability –

quantification of basic events (for non-repairable components, hazard rate, exponential distribution, Weibull distribution)

Unit-4

Quantification of basic events -repair to failure, repair-failure-repair, and combined processes, Computation of combined process parameters – Laplace transform and Markov analysis, Safety vs reliability – quantification of basic events, Systems safety quantification (e.g., truth tables, structure functions, minimal cut sets)

Unit-5

Human error -classification and causes, Human error identification, Human reliability assessment, analysis and safety, Accident investigation and analysis, control chart analysis, regression and classification tree, OSHAS 18001 and OSHMS- part I, II, III and safety performance indicators, Energy isolations, Application of virtual reality.

Books and references:

1. Probabilistic Risk Assessment for Engineering and Scientists, Komamoto and Henley, IEEE Press, 1995.

2. Industrial Accident Prevention, Heinrich et al., McGraw Hill, 1980.

3. Techniques for safety management - A systems approach, Petersen D, ASSE 1998.

Introduction to Machine Learning

23UD2608OE301C	Introduction to Machine Learning	Open Elective	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None
Course Outcomes: At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1 Statistical basics for Machine Learning
Introduction, Statistical Decision Theory, Regression, Classification, Bias Variance, Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Partial Least squares

Unit 2 Neural Network Learning
Linear Classification, Logistic Regression, Linear Discriminant Analysis, Week 4: Perceptron, Support Vector Machines, Neural Networks - Introduction, Early Models, Perceptron Learning, Backpropagation, Initialization, Training & Validation, Parameter Estimation - MLE, MAP, Bayesian Estimation

Unit 3:
Decision Trees, Regression Trees, Stopping Criterion & Pruning loss functions, Categorical Attributes, Multiway Splits, Missing Values, Decision Trees - Instability Evaluation Measures, Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL, Ensemble Methods - Bagging, Committee Machines and Stacking, Boosting

Unit 4:
Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks, Undirected Graphical Models, HMM, Variable Elimination, Belief Propagation, Partitional Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering

Unit 5:
Gaussian Mixture Models, Expectation Maximization, Learning Theory, Introduction to Reinforcement Learning, Optional videos (RL framework, TD learning, Solution Methods, Applications)

TEXTS/REFERENCES:

1. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, "Learning from Data", AMLBook Publishers, 2012.
2. P. Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012.
3. K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.
4. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
5. D. Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 2012. M. Mohri, A. Rostamizadeh, and A. Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.
6. T. M. Mitchell, "Machine Learning", McGraw Hill, 1997. 8. S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall, 2009.

7. The Elements of Statistical Learning, by Trevor Hastie, Robert Tibshirani, Jerome H. Friedman
8. NPTEL Resource: Introduction to Machine Learning, By Prof. Balaraman Ravindran from IIT Madras

COMPUTER CONTROL IN PROCESS PLANNING

23UD2608OE302A	COMPUTER CONTROL IN PROCESS PLANNING	Open Elective	3-0-0	3 Credits

Mid Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites:

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Program Outcomes Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT 1 INTRODUCTION

The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning – Process Planning and Concurrent Engineering, CAPP, Group Technology

UNIT 2 PART DESIGN REPRESENTATION

Design Drafting - Dimensioning - Conventional tolerance - Geometric tolerance - CAD - input /output devices - topology- Geometric transformation- Perspective transformation –Data structure - Geometric modelling for process planning- GT coding - The optiz system - The MICLASS system.

UNIT 3 PROCESS ENGINEERING AND PROCESSPLANNING

Experienced-based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, Al.

UNIT 4 COMPUTER AIDED PROCESS PLANNING SYSTEMS

Logical Design of a Process Planning - Implementation considerations -manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

UNIT 5 AN INTERGRADED PROCESS PLANNING SYSTEMS

Totally integrated process planning systems - An Overview - Modulus structure - Data Structure, operation –Report Generation, Expert process planning.

REFERENCES:

1. Chang, T.C., "An Expert Process Planning System ", Prentice Hall,1985.
2. Gideon Halevi and Roland D.Weill, "Principles of Process Planning", A logicalapproach,Chapman &Hall,1995.
3. Nanua Singh,"SystemsApproachtoComputerIntegratedDesignandManufacturing",John Wiley & Sons, 1996.
4. Rao, "Computer Aided Manufacturing", Tata Mc Graw Hill Publishing Co.,2000.
5. Tien-Chien Chang, Richard A. Wysk, "An Introduction to automated process planningsystems", Prentice Hall,1985.

WEB REFERENCES:

1. http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm
2. http://Estraj.ute.sk/journal/engl/027/027.htm

e-Commerce Technologies

23UD2608OE302B	e-Commerce Technologies	OEC-II	3-0-0	3 Credits

Mid SemTest 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: Engineering mathematics-I

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Unit-1

Introduction to e-commerce, Technical components and functions of e-commerce, Advantages and disadvantages of e-commerce, Scope and applications of e-commerce, E-commerce and e-business

Unit-2

Evolution of internet, Domain names and internet organization, Types of network, Role of internet in B2B application and Building own website, Web promotion, Target email, Banner exchange and Shopping Bots, Secure transaction over internet

Unit-3

Privacy issues, Computer crime, Threats and attacks on computer system, Software packages for privacy, Hacking and computer virus, Security algorithms, Authorization and authentication, digital signature, Firewall, Basic concepts of EDI

Unit-4

Applications of EDI, EDI model and Disadvantages of EDI model, Introduction to electronic payment systems, Payment types, Planning e-commerce initiates, Linking objectives to business strategies, Managing costs, Strategies for developing e-commerce websites

Unit-5

Pros and cons of online shopping, Case study- cons of online shopping, E-cycle of internet marketing, Internet marketing techniques, Personalization of e-commerce.

TEXTS/REFERENCES:

1. C.S.V.Murthy, E-Commerce Concepts, Models, Strategies- :- Himalaya Publishing House, 2011.
2. Kamlesh K Bajaj and Debjani Nag , E- Commerce , 2005.
3. Gary P. Schneider , Electronic commerce, International Student Edition, 2011.
4. Electronic Commerce: The Strategic Perspective, Richard T.Watson, Pierre Berthon, Leyland F. Pitt, George M. Zinkhan.
5. Rana tassabehji, Applying E-commerce in business, 2003.
6. Kalakota, Ravi and Whinston, Andrew B., Electronic Commerce – A Manager‘s Guide, Pearson Education, Inc.
7. William Stallings, Cryptography and Network security Principles and practice, Fifth edition.
8. Bharat Bhasker, Electronic commerce-framework, technologies and applications, 3rd edition.

Entrepreneurship & Start-ups

23UD2608OE302C	Entrepreneurship & Start-ups	PC	3-0-0	3 Credits

Mid SemTest 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None
Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1
Understanding the meaning of Start Up
Why Start Ups are growing immensely these days, Characteristics of Successful Entrepreneur, Theories & Types of Entrepreneurs, Understanding the Start Up Ecosystem

Unit 2
Idea Generation:
Introduction to Design Thinking, Idea Identification, Genuity of Idea, Understanding what customers really want?, Market Research: Validation of idea, Testing your idea with real time user into the market, Selection a demographic area for implementing your idea, Building of Minimum Viable Product

Unit 3

Soft Skills required to handle StartUp:

Leadership, Negotiation skills, Time management, Problem solving, Communication

Unit4

StartUp Plan:

Making Business Plan of your startup, Understanding the legal compliances of your startup, building marketing strategies to get your product into the market (Traditional & Digital Marketing), Understanding Cash Flow Management, Raising funds for your business

Unit 5

MANAGEMENT OF SMALL BUSINESS

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

Intellectual Property Rights

MFE32	Intellectual Property Rights	PC	3-0-0	3 Credits

Mid SemTest 20 Marks	Continuous Assessment 20 Marks	End-Semester Exam 60 Marks	Total 100 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit-1

- Introduction to IPR; Overview & Importance; IPR in India and IPR abroad; Patents ;their definition; granting; infringement ;searching & filing; Utility Models an introduction;

Unit-2

- Copyrights ; their definition; granting; infringement; searching & filing, distinction between related and copy rights; Trademarks , role in commerce, importance, protection, registration; domain names;

Unit-3

- Industrial Designs ; Design Patents; scope; protection; filing infringement; difference between Designs & Patents' Geographical indications, international protection; Plant varieties; breeder's rights, protection; biotechnology& research and rights managements; licensing, commercialization; ; legal issues, enforcement; Case studies in IPR.

TEXT BOOKS/REFERENCES:

1. Prabuddha Ganguli, IPR: Unleashing the Knowledge Economy, published by Tata McGraw Hill 2001.

Project Stage -1

23UD2612PC303	Project Stage – I	PCC	0-0-0	10 Credits

Continuous Assessment 50 Marks	End Sem Evaluation 50 Marks	Total 100 Marks

Pre-Requisites: Previously studied courses.
Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Objective:
To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

The project work can be a design project, experimental project, computer simulation project or an empirical study involving data collection and analysis from manufacturing organisations. The topic should be on Manufacturing Systems Management orany of the topics related with Manufacturing stream. The project work is allotted individually on different topics.The students shall be encouraged to do their project work in the parent institute. If found essential they may be permitted to continue their project outside the parent institute subject to the conditions of M.Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members. The student is required to undertake the masters research project phase-I during the third semester and the same is continued in the 4^{th} semester (Phase-II). Phase-I consists of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the

topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester.

Semester IV

Project Stage – II

23UD2608PC304	Project Stage – II	PCC	0-0-0	20 Credits

Continuous Assessment 100 Marks	PR/OR 100 Marks	Total 200 Marks

Pre-Requisites: Previously studied courses.
Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Objectives:
To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Masters Research project phase-II is a continuation of project phase-I started in the third semester. Before the end of the fourth semester, there will be two reviews, one at middle of the fourth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre-qualifying exercise for the students for getting approval for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.