JHARKHAND UNIVERSITY OF TECHNOLOGY, RANCHI

M. Tech. (CAD/CAM) Semester-I

Sr. No.	Course Type	Code	Course Name	Credits
1	Core-I	CAD1101	Computer Aided Design	3
2	Core-II	CAD1102	Computer Aided Manufacturing	3
3	Program Elective-I	CAD1103 CAD1104 CAD1105	1. Mechatronics 2. Computer Aided Inspection and Testing 3. Data Base Management Systems	3
4	Program Elective-II	CAD1106 CAD1107 CAD1108	1. Advanced Machining Processes 2. Modelling and Simulation 3. Advanced Mechanisms	3
5	Program Elective-III	CAD1109 CAD1110 CAD1111	1. Rapid Prototyping and Manufacturing 2. Product Design & Development 3. Machine Condition Monitoring	3
6	Core	CAD1201	Lab-I Computer Aided Design Lab	2
7	Core	CAD1202	Lab-II Computer Aided Manufacturing Lab	2
8	Core	RMC1101	Research Methodology and IPR	2
9	Audit Course - 1	A10001	1.English for research Paper writing 2. Sanskrit for technical knowledge 3. value Education 4. Constitution of India	-
			Total Credit	21

M. Tech. (CAD/CAM) Semester-II

Sr. No.	Course Type	Code	Course Name	Credits
1	Core-III	CAD2101	Computer Integrated Manufacturing	3
2	Core-IV	CAD2102	Finite Element Method	3

3	Program Elective-IV	CAD2103 CAD2104 CAD2105	1. Robotics 2. Data Communication and Networking 3. Modelling and Simulation	3
4	Program Elective-V	CAD2106 CAD2107 CAD2108	1. Mechanical Vibrations 2. Fracture Mechanics and Non Destructive Testing 3. Design for Manufacturing & Assembly	3
5	Open Elective-I	CAD2109 CAD2110 CAD2111 CAD2112 CAD2113 CAD2114	1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy	3
6	Core	CAD2201	Lab-III Computer Integrated Manufacturing / FMS Lab	2
7	Core	CAD2202	Lab-IV Finite Element Method	2
8	Core	CAD2203	Mini-Project	2
8	Audit Course - II	A20001	1. Disaster Management 2. Value Education 3. Pedagogy Studies 4. Personality Development through Life Enlightenment Skills.	-
			Total Credit	21

M. Tech. (CAD/CAM) Semester-III

Sr. No.	Course Type	Code	Course Name	Credits
1	Dissertation	CAD3201	Dissertation Phase – I	10
			Total Credit	10

M. Tech. (CAD/CAM) Semester-IV

Sr. No.	Course Type	Code	Course Name	Credits
1	Dissertation	CAD4201	Dissertation Phase – II	16
			Total Credit	16

Computer Aided Design

Course Outcomes:

At the end of the course:

1. Have a conceptual understanding of the principles of CAD systems, the implementation of these principles, and its connections to CAM and CAE systems.
2. Understand 2D, 3D transformations and projection transformations.
3. Get knowledge of various approaches of geometric modeling.
4. Understand mathematical representation of 2D and 3D entities.
5. Understand basic fundamentals of FEM.

Syllabus Contents:

Unit 1: CAD Hardware and Software, Types of systems and system considerations, input and output devices, hardware integration and networking, hardware trends, Software modules,

Unit 2: Computer Communications, Principle of networking, classification networks, network wring, methods, transmission media and interfaces, network operating systems,

Unit 3: Computer Graphics Introduction, transformation of geometric models: translation, scaling, reflection, rotation, homogeneous representation, concatenated transformations; mappings of geometric models, translational mapping rotational mapping, general mapping, mappings as changes of coordinate system; inverse transformations and mapping;

Unit 4 : Projections of geometric models, orthographic projections, Geometric Modeling, curve representation: Parametric representation of analytic curves, parametric representation of synthetic curves, curve manipulations. Surface representation,

Unit 5 : Fundamentals of solid modeling, boundary representation (B-rep), Constructive Solid Geometry (CSF), sweep representation, Analytic Solid Modeling (ASM), other representations; solid manipulations, solid modeling based applications: mass properties calculations, mechanical tolerancing, etc.

References:

1. Ibrahbim Zeid, “CAD / CAM Theory and Practice”.
2. Jim Browne, “Computer Aided Engineering and Design”.
3. P. Radhakrishnan / V. Raju / S. Subramanyam, “CAD / CAM / CIM”.
4. P.N. Rao, “CAD / CAM principles and applications”, Tata Mcraw-Hill, 02.
5. Rogers / Adams, “Mathematical Elements for Computer Graphics”.
6. Rooney and Steadman, “Principles of Computer Aided Design”, Aug. 1993.
7. Jerry Banks / John Carson / Barry Nelson / David Nicol, “Discrete-Event System Simulation”

Computer Aided Manufacturing

Course Objectives:

Students will gain a basic understanding of computer numerical control (CNC) machining processes and operations using a combination of G-codes, milling and turning machines.

Course Outcomes: The students which finish this course in a satisfactory manner will be able

1. To demonstrate a basic understanding of machining fundamentals including speed and feed calculations, tooling systems, and work-holding systems for CNC milling and turning equipment.
2. To demonstrate a basic and advanced understanding of numerical controlled (NC) programming strategies.
3. To demonstrate an ability to set-up, program, and operate CNC milling and turning equipment.
4. To demonstrate an ability to generate NC code using G-codes to machine parts to specifications.

Syllabus:

CAM - concept and definition : NC (Numerical Control), CNC (Computerized Numerical Control) and DNC (Direct Numerical Control) - concept, features and differences. Advantages and limitations of CNC,

Selection criteria for CNC machines. CNC machines: Types, classification, working and constructional features. Spindle drives and axes drives on CNC machines. Machine structure- Requirements and reasons. Elements of CNC machines - Types, working and importance of: Slide ways, Re-circulating ball screw, Feedback devices (transducers, encoders), Automatic tool changer (ATC), Automatic pallet changer (APC), CNC axes and motion nomenclature.

CNC tooling : i. Tool presetting-concept and importance, Qualified tools-definition need and advantages, . Tool holders- types and applications. CNC turning and Milling centers: Types, Features, Axes nomenclature, Specification, Work holding devices -types, working and applications, Tool holding and changing devices - types, working and applications.

CNC part programming: Definition and importance of various, positions like machine zero, home position, work piece zero and program zero, programming format and structure of part program. ISO G and M codes for turning and milling-meaning and applications of important codes. Simple and Complex part programming for turning and milling using ISO format having straight turning, taper turning (linear interpolation) and convex/concave turning (circular interpolation), ISO format milling. Importance, types, applications and format for: i. Canned cycles ii. Macro iii.Do loops iv. Subroutine CNC turning and milling part programming using canned cycles, Do loops and Subroutine, Need and importance of various compensations: i. Tool length compensation. ii. Pitch error compensation. iii. Tool radius compensation. iv. Tool offset. Simple and Complex part programming using various compensations.

Recent Trends in CAM :Interfacing standards for CAD/CAM - Types and applications, Adaptive control-definition, meaning, block diagram, sources of variability and applications. Flexible Manufacturing System (FMS) - concept, evaluation, main elements and their functions, layout and its importance, applications, Computer Integrated Manufacturing (CIM) - Concept, definition, areas covered, benefits. Robotics-definition, terminology, classification and types, elements and applications. Rapid prototyping - Concept and application

Reference Books:

1. Pabla B.S., Adithan M.., "CNC Machines", New Age International, New Delhi, 2014 (reprint)
2. Quesada Robert, "Computer Numerical Control Turning and Machining centers.", Prentice Hall 2014.
3. Groover, M. P., Zimmer, W.E., "CAD/CAM: computer aided design and manufacturing", Prentice Hall.
4. Rao, P. N., Tiwari, N. K., Kundra, T., "Computer Aided Manufacturing.", CBS Publ. N-Delhi, 1995.

Mechatronics

Introduction to Mechatronics systems and components. Principles of basic electronics –Digital logic. Number system logic gates. Sequence logic flip Hop system. JK flip Hop, D-flip flop.

Microprocessors and their applications - Microcomputer computer structure/microcontroller. Integrated circuits-signal conditioning processes, various types of amplifiers, low pass and High pass filters.

Sensors- Sensors and transducers, displacement. Position proximity sensors. Velocity, force sensors Fluid presence temperature. Liquid level and light sensors. Selection of sensors. Actuators, Pneumatic and Hydraulic systems. Mechanical actuation system. Electrical actuation system. Other Electrical/ electronic hardware in mechatronics system.

Principles of Electronic system communication- Interfacing. AD and DA converters. Software and hardware principles and tools to build mechatronic systems. Basic system models. Mathematical models. Mechanical and other system building blocks.

System models- Engg. Systems. Rotational, translation. Electro mechanical: Hydraulic mechanical system. System transfer functions, first - second order system in series.

Design and selection of Mechatronics Statements namely sensors line encoders and revolvers, stepper and servomotors ball screws, solenoids, line actuators and controllers with application to CNC system. Robots. Consumer electronics products etc. Design of a mechatronic product using available software CAD packages. MATLAB and SIMULINK.

Reference Books:

1. Mechatronics by W. Bolton; Addison Wesley Longman Pvt. Ltd.
2. Automation Production System and CIMS by Mikel P Groover; Prentice Hall.
3. Mechatronics by Hegde; Jones and Bartlett
4. Applied Mechatronics by Samili and Mrad Oxford University Press
5. Design with Microprocessors for Mechanical Engineers by Stiffler McGraw-Hill

Computer Aided Inspection and Testing

INTRODUCTION: Computer aided testing (CAT) and computer aided inspection (CAI), computer aided quality control (CAQC), on-line inspection and quality control, technology of automation Gauging, automatic inspection machines, in-process gauging.
CO-ORDINATE MEASURING MACHINES: Basic Types of Measuring Machines, probe types, operating modes, programming software's, accessories, measurement and inspection capabilities, flexible inspection systems, inspection problems.
MACHINE VISION: Functions of machine vision system, evaluating the performance of machine vision system, machine vision applications.
SCANNING LASER BEAM DEVICES: Laser interferometer, laser, alignment devices, X-ray optics, CCD (Charge-coupled Devices) Array, ultrasonic system.
MACHINE TOOL SENSING: Part measurement, Tool wear, Axial, motion, Sequence of functions, tool Identification. Computer aided surface roughness measuring systems, High accuracy profile measuring systems.
PROXIMITY SENSING: Photoelectric Transducers, Image processing for vision sensor, 3D object recognition.

Reference Books:

1. Machine Vision-Nello Zueh and Richard K.Miller prentice hall,1987
2. Roborts Sensor -Pugh, IFS Publication, 1986
3. Transducers and Interfacing -Bannister and Whitehead~ Von Nostrand. 1986
4. Computer Control of Manufacturing Systems -Koren, McGraw Hill, 1983

Database Management Systems

INTRPODUCTION: Concept of DBMS, characteristics, frontend and backend actors, advantages, database applications
DATABASE SYSTEM ARCHITECTURE Data models, instances, schemas, three schema architecture, database system environment, centralised and client server architecture of DBMS, classification of DBMS.
DATA MODELLING High level conceptual data models for database design, example of database application, entity types, entity sets, attributes and keys, relationship types, relationship sets roles and structural constraints, weak entity, ER diagram conventions, total participation, partial participation, extended ER features, specialization, generalization, attribute inheritance, design constraints, aggregation, primary key, super key, foreign key, trigger.
RELATIONAL DATA MODEL Relational model concepts, domain attributes, tuples and relations, characteristics of relations, relational model constraints, relational database schema.
RELATIONAL ALGEBRA Relational algebra and expression, relational calculus, types of operators: Urinary operator (select, projection and rename operator), binary operator (union intersectional and minus operator), Cartesian product, binary relational operation, joint operation, division operation.
DATABASE DESIGN THEORY AND METHODOLOGY Problems with DBMS, functional dependencies, closure of a set of functional dependency, canonical curve, decomposition, Normalization, 1NF, 2NF, 3NF and BCNF, 4NF, 5NF. Test for lossless decomposition,
SQL: SCHEME DEFINITION, CONSTRAINTS AND QUERRIES SQL data definition and data types, schema and catalogue concept for SQL, create table demand, attribute data type, constraints, schema change statement, basic queries in SQL, ambiguity, use of asterisk and key word “distinct”, aggregate functions, grouping, insert, delete and update statement.

Reference Books:

1. Fundamentals of database systems by Elamsari and Navathe
2. Database System Concepts by Silberschatz, Korth, Sudarshan, Mc Graw Hill

Advanced Machining Processes

Course Objectives:

The aim of the course is to enrich the fundamentals of machining processes both conventional and unconventional processes. The course elaborates the mathematical formulations of various machining processes and analyse the influence of various process parameters in each process. This also enables the student to understand the process and further the course provides an insight to choose his research career.

Course Outcomes:

At the end of course the students will be able to:

1. Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.
2. Relate Generation and control of electron beam for machining, laser beam machining, comparison of thermal and non-thermal processes
3. Differentiate Thermal Metal Removal Processes, characteristics of spark eroded surface, machine tool selection and various finishing techniques.

Syllabus:

Advanced Metal Cutting and Grinding :Modeling of cutting process: Review of cutting mechanism; Cutting force model; Oblique Cutting; Temperature analysis (Finite Difference Method); Wear model; Evaluation of surface quality; Cutting processes for producing various shapes

Gear machining: Hobbing , Modeling of grinding process: Grinding force model; Temperature analysis; Wheel life model., Introduction of finishing process: Machining mechanism in finishing: Honing, Lapping, Super finishing, etc.

Micro-Nano Precision Machining: Introduction to nano-precision mechanical manufacturing: M4 processes

Nano-precision cutting: Machine & tool; Brittle / ductile transition; Ductile mode cutting of brittle materials

Nano-precision grinding: Machine & grinding wheel; Truing & dressing; Cutting edge evaluation; Applications to extreme optics, Nano-precision polishing: Conventional polishing; Non-conventional polishing; Plane honing; Field-assisted fine finishing

Unconventional Machining Processes :Electric Discharge Machining (EDM); Electron Beam Machining (EBM); Plasma Arc Machining (PAM); Laser Beam Machining (LBM); Ultrasonic Machining (USM); Abrasive Jet Machining (AJM); Water Jet Cutting (WJC), Abrasive Water Jet Machining (AWJM); Electro-Chemical Machining (ECM); Chemical Machining (CHM)

Reference Books:

1. Boothroyd, G and Knight, W A., “Fundamentals of Machining and Machine Tools”, 3rd Third Edition, Saint Luice Pr, 2005.
2. G.F. Benedict, “Non-traditional Manu. Processes”, Marcel Dekker, Inc. New York, 1987.
3. P.C. Pandey, and H.S. Shan, “Modern Machining Processes”, Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 1980.
4. J.A. McGeough, “Adv. Methods of Machining”, Chapman and Hall, London, 1988.

Modelling and Simulation

INTRODUCTION Simulation: a tool, advantages and disadvantages of simulation, areas of application, systems and system environment, components of a system, discrete and continuous systems, discrete event system simulation.

GENERAL PRINCIPLES Concepts in discrete event simulation, time advance algorithm, manual simulation using event scheduling, basis properties and operations.

MOEDLS IN SIMULATION Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Bionomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution; Gamma distribution; Normal distribution; Weibull distribution; Triangular Distribution; Lognormal distribution, poisson process.

QUEUEING MODELS Characteristics of queuing systems, the calling population, system capacity, arrival process, service mechanism, queuing notations, long run measures of performance of queuing systems, server utilization in G/G/1/∞/∞ queues, server utilization in G/G/C/∞/∞ queues, server utilization and system performance, costs in queuing problems, Larkovian models.

RANDOM NUMBER GENERATION Properties of random numbers, Pseudo random numbers, techniques of generating random numbers, tests of random numbers.

RANDOM VARIATE GENERATION Inverse transform technique, Direct transformation for the Normal and Lognormal distribution, Convolution Method, Acceptance rejection technique.
INPUT MODELLING AND VALIDATION Steps in the development of model, data collection, Distribution identification, Parameter estimation, Goodness of Fit Tests, selecting input models without data, verification and validation of simulation models.

Reference Books:

1. Simulation Modelling and Analysis by Law and Kelton, Mc Graw Hill, 1991
2. Simulation Model Design& execution by Fishwich, Prentice Hall, 1995
3. Discrete event system simulation by Banks, Carson, Nelson and Nicol

Advance Mechanisms

Course Objectives:

1. Provide theoretical background for basic and advanced kinematics and synthesis of mechanisms to achieve desired motion.
2. Introduce basic and advanced computer-based tools for analysis and synthesis of mechanisms.
3. Provide an opportunity for students to use theory and application tools through a major mechanism design project.

Course Outcomes:

1. Students gain a solid theoretical background in kinematics and in the analysis and synthesis of mechanisms.
2. Students become familiar with basic and advanced computer-based engineering tools for the analysis and design of linkages.
3. Students have the ability to apply theory and the use of practical engineering tools in a substantial mechanism design project.

Syllabus:

Introduction to kinematics, types of mechanism, kinematics synthesis, science of relative motion, tasks of kinematic synthesis with practical applications, Degree of freedom, class-I, class-II chain, Harding's notation, Grashof criterion, Grubler's criterion. Introduction to position generation problem, concept of pole, two & three position generation synthesis, pole triangle, Relationship between moving & fixed pivots, Four position generation, opposite pole quadrilateral, center point & circle point curve, Burmester's point. Matrix method for position generation problem, rotation matrix, displacement matrix.
Introduction to function generation problem, co-ordination of input-output link motion, relative pole technique, inversion technique, overlay technique, graphical synthesis of quick return mechanisms for optimum transmission angle. Types of errors, accuracy points cheby shev's spacing and frudenstein's equation. Introduction to path generation problem, synthesis for path generation with and without prescribed timing using graphical method. Coupler curves, cognate linkages, Robert's law of cognate linkages. Complex number method for path generation problem 3 precision point. Synthesis for infinitesimally separated position, concept of polode and centrod, Euler's savery equation, inflection circle, Bobbilier and Hartman's construction. Optimal synthesis of planer mechanisms, least square method. Introduction to spatial mechanisms, D-H notations, Introduction to kinematic analysis of robot arms.

Reference Books:

1. Tad D.C, "Applied linkage synthesis", Addison Wesley publication , 1964.
2. Sandor G.N., Erdman, A. G, "Advanced mechanism design", Prentice Hall Inc, 1984
3. Suh C.H., Radcliff C.W ," Kinematics and mechanisms design", John Wiley &Sons., 1978.

Computer Aided Design Lab

Course Objectives:

1. To learn graphics software.
2. To perform various CAD operations using software.
3. To learn programming for analysis of mechanical elements.

Course Outcomes:

1. Upon successful completion students will be able to:
2. Operate graphics software for various Cad applications.
3. Carry out programming for optimization of design.
4. Use customized FEM software for real application of CAD.

List of Experiments:

1. Development of software for design of any mechanical element and system.
2. Development of menu driven software for graphics using output primitives.
3. Development of software for transformation using scaling, rotation, reflection.
4. Development of software for clipping of graphical entities.
5. Development of software for analysis of one dimensional element using FEM technique.
6. Software operation of customized FEM software.
7. Development of computer program for analysis of mechanical element using FEM for user input values.
8. Development of software for analysis of stress problem using FEM.
9. Development of software for design optimization of mechanical element using Johanson method.
10. Use of commands of any computer aided drafting software package viz. AutoCAD, Pro-engineer.

Computer Aided Manufacturing Lab

Research Methodology and IPR

Course Outcomes:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics.
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Syllabus Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics.

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners"

4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New
9. Technological Age”, 2016.
10. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Computer Integrated Manufacturing

Course Objectives:

This course aims to acquaint the students with principles, concepts and techniques that are essential in Computer Integrated Manufacturing.

Course Outcomes:

1. Understand the effect of manufacturing automation strategies and derive production metrics.
2. Analyze automated flow lines and assembly systems, and balance the line.
3. Students will have an introduction to Computer Aided Process Planning (CAPP) Systems, Robotic Systems, Group Technology and Cellular Manufacturing Systems.
4. Students will cultivate understanding about Automated Material Handling Systems, Automated Inspection Systems, Flexible Manufacturing Systems (FMS).

Syllabus:

Manufacturing Automation: Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Strategies-The USA Principle, Ten Strategies for Automation and Process Improvement, Automation Migration Strategy. Automated Flow lines: System Configurations, Workpart Transfer Mechanisms, Storage Buffers, Control of Production Line, Analysis of Transfer Lines-Transfer Lines with No Internal Parts Storage, Transfer Lines with Internal Storage Buffers. Manual Assembly Lines: Assembly Workstations, Work Transport Systems, Line Pacing, Coping With Product Variety, Analysis of Single Model Assembly Lines-Repositioning Losses, The Line Balancing Problem, Line Balancing Algorithms-Largest Candiate Rule, Kilbridge and Wester Method, Ranked Positional Weights Method. Automated Assembly Systems: System Configurations, Parts Delivery at Workstations, Applications, Quantitative Analysis of Assembly Systems- Parts Delivery System at Workstations, Multi-station Assembly machines, Single Station Assembly Machines, Partial Automation. Automatic Material Handling and Storage systems: Design Considerations in Material Handling, Material Transport Equipment-Industrial Trucks, Automated Guided Vehicles, Monorails and Other Rail-Guided Vehicles, Conveyors, Cranes and Hoists, Analysis of Vehicle Based Systems, Conveyor Analysis. Automated Storage/Retrieval Systems, Carousel Storage Systems, Engineering Analysis of AS/RS and Carousel Systems. Automated Inspection systems: Overview of Automated Identification Methods, Bar Code Technology, Radio Frequency Identification, Other AIDC Technologies-Mangnetic Stripes, Optical Character Recognition, and Machine Vision. Cellular Manufacturing Systems: Part Families, Parts Classification and Coding, Features of Parts Classification and Coding Systems, Opitz of Parts Classification and Coding Systems, Production Flow Analysis, Composite Part Concept, Machine Cell Design, Applications Of Group Technology, Quantitative analysis of Cellular Manufacturing, Grouping of parts and Machines by Rank Order Clustering, Arranging Machines in a GT Cell. Computer Aided Process Planning: Retrieval CAPP Systems, Generative CAPP Systems, Feature Identification- Algorithms, Graph Based Approach, Attribute Adjacency Graph, Benefits of CAPP. Flexible Manufacturing Systems: Flexibility, Types Of FMS-A Dedicated FMS, A Random Order FMS, FMS Components-Workstations, Material Handling and Storage Systems, Computer Control System, Human Recourses, FMS Applications and Benefits Computer Integrated Manufacturing: The Scope of CAD/CAM and CIM, Computerized elements of a CIM System, Components of CIM, Database for CIM, Planning , Scheduling and Analysis of CIM Systems.

Reference Books:

1. Mikell P Groover, “ Automation, production Systems and Computer Integrated Manufacturing,”
2. 3rd Edition, Prentice Hall Inc., New Delhi, 2007.
3. Nanua Singh, “System Approach to Computer Integrated Manufacturing,” Wiley & Sons Inc., 1996.

4. Andrew Kusiak, “Intelligent Manufacturing System,” Prentice Hall Inc., New Jersey, 1992.

Finite Element Method

Course Outcomes:

At the end of the course, the student will be able to demonstrate the learning outcomes as mentioned below:

1. The student will be able to classify a given problem on the basis of its dimensionality as 1-D, 2-D, or 3-D, time-dependence as Static or Dynamic, Linear or Non-linear.
2. The students will be able to develop system level matrix equations from a given mathematical model of a problem following the Galerkin weighted residual method or principle of stationary potential.
3. While demonstrating the process mentioned in 2 above, he will be able to identify the primary and secondary variables of the problem and choose correct nodal degrees of freedom and develop suitable shape functions for an element, implement Gauss-Legendre scheme of numerical integration to evaluate integrals at element level, and assemble the element level equations to get the system level matrix equations. He will also be able to substitute the essential boundary conditions correctly and obtain the solution to system level matrix equations to get the values of the field variable at the global nodes.
4. The student will be able to state three sources of errors in implementing FEM and suggest remedies to minimize the same for a given problem, viz. Modeling errors, Approximation errors, and numerical errors.
5. The student will be able to obtain consistent and lumped mass matrices for axial vibration of bars and transverse vibration of beams and obtain fundamental frequency of natural vibration using the methods mentioned in the curricula.
6. The students will be able use MATLAB for implementation of FEM to obtain elongations at nodes of a bar subjected to traction and concentrated loads and prescribed boundary Conditions.
7. The students will be able to use commercial software like ANSYS or ABAQUS for Implementation of FEM to obtain stress concentration due to a small hole in a rectangular plate subjected to traction on edges and concentrated loads at points on the edges and prescribed boundary conditions

Syllabus Contents:

Unit 1: Introduction, Classification of problems – Dimensionality, time dependence, Boundary Value problems, Initial value problems, Linear/Non-linear, etc,

Unit 2: Differential equation as the starting point for FEM, steps in finite element method, discretization, types of elements used, Shape functions, Linear Elements, Local and Global coordinates, Coordinate transformation and Gauss-Legendre scheme of numerical integration, Nodal degrees of freedom,

Unit 3: Finite element formulation, variational, weighted residual and virtual work methods.

Unit 4: 1-D and 2-D problems from Structural Mechanics – Bar, Beam, Plane stress and plane strain problems, Axisymmetric problems – Axi-symmetric forces and geometry,

Unit 5: computer implementation, higher order elements, iso-parametric formulation,

Unit 6: Eigen-value problems, Natural vibration of bars and beams, Methods to find eigen-values and eigen-vectors.

References:

1. Chandrupatla and Belegundu “Introduction to Finite Elements in Engineering”, Prentice
2. Hall of India Pvt. Ltd. New Delhi, Ed.4, 11.
3. Logan Deryl L., “A First Course in Finite Element Method”, Thomson Brook/Cole, 5^{th} Ed.
4. Cook R.D. “Concepts and applications of finite element analysis” Wiley, New York, 4^{th} Ed.
5. Reddy J N, “Finite element Method”, Tata McGraw Hill publishing Co Ltd, New Delhi, 3^{rd} Ed.
6. Bathe K.J., Cliffs, N.J. “Finite Element Procedures in Engineering Analysis”, PHI Learning, Eastern Economy Editions, 09.

Robotics

Course Outcomes:

At the end of the course students will be able to

1. understand basic terminologies and concepts associated with Robotics and Automation
2. demontrate comprehension of various Robotic sub-systems
3. understand kinematics and dynamics to explain exact working pattern of robots
4. aware of the associated recent updates in Robotics

Syllabus Contents

Unit 1 Introduction:

Basic Concepts such as Definition, three laws, DOF, Misunderstood devices etc., Elements of Robotic Systems i.e. Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc. Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.

Unit 2 Robot Grippers:

Types of Grippers , Design aspect for gripper, Force analysis for various basic gripper system. Sensors for Robots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.

Unit 3 Drives and control systems:

Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems, Control Systems -Types of Controllers, Introduction to closed loop control Control Technologies in Automation:- Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Control System Components such as Sensors, Actuators and others.

Unit 4 Kinematics:

Transformation matrices and their arithmetic, link and joint description, Denavit – Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities and Static forces in manipulators:- Jacobians, singularities, static forces, Jacobian in force domain.

Dynamics:- Introduction to Dynamics , Trajectory generations

Unit 5 Machine Vision System:

Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques , Noise reduction methods, Edge detection, Segmentation. Robot Programming :- Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VAL II etc, Features of type and development of languages for recent robot systems.

Unit 6 Modeling and Simulation for manufacturing Plant Automation:

Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.

Artificial Intelligence:- Introduction to Artificial Intelligence, AI techniques, Need and application of AI. Other Topics in Robotics:- Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics.

References:

1. John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2nd Edition, 04.
2. Mikell P. Groover et. Al., Industrial Robotics: Technology, Programming and Applications, McGraw – Hill International, 1986.
3. Shimon Y. Nof , Handbook of Industrial Robotics , John Wiley Co, 01.

4. Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover, Pearson Education.
5. Industrial Automation: W.P. David, John Wiley and Sons.
6. Richard D. Klafter , Thomas A. Chemielewski, Michael Negin, Robotic Engineering : An Integrated Approach , Prentice Hall India, 02.
7. Handbook of design, manufacturing & Automation: R.C. Dorf, John Wiley and Sons.

Data Communication and Networking

Computer networks and the Internet: Internet, service description, protocol, network protocols, Network edge, end systems, clients, servers, connectionless and connection oriented service, network core, circuit switching and packet switching, multiplexed in circuit switched networks, message segmenting, packet forwarding in computer networks, virtual circuit networks, datagram networks, network access, company access, mobile access, physical media, delay and loss in packet switched networks, delay and routes in internet, protocol layers, internet protocol stack, network entities and layers.

Application Layer Principles of application layer protocols, client server sides of an application, process communicating across a network, addressing process, user agent, reliable data transfer, timing in transfer, services provided by the internet transport protocols, Web and HTTP, non persistent and persistent connections, HTTP message format, user server interaction, authorization and cookies, HTTP content, File transfer: FTP, FTP commands and replies, SMTP, Mail access Protocols, DNS and records, content distribution, Web catching, cooperative catching, Peer to peer file sharing, centralised and decentralised directory, query flooding.

Transport Layer Transport layer services, relationship between transport and network layer, transport layer in the internet, multiplexing and demultiplexing, connection oriented multiplexing and demultiplexing, web server and TCP, connection less transport: UDP, UDP segment structure, reliable data transfer, positive and negative acknowledgements, duplicate packets, stop and wait protocols, acknowledge fields, pipelining, Go – Back – N, Selective repeat, connection oriented transport: TCP, TCP segment structure, sequence numbers and acknowledgement numbers, round trip time estimation and timeout, reliable data transfer, Doubling the time out interval, flow control, TCP connection management, congestion control, approaches to congestion control, TCP congestion control.

Network layer and routing Network service models, origins of datagram and virtual circuit service, routing principles, Hierarchical routing, Internet Protocol, IPv4 addressing, obtaining a network address, obtaining a host address, moving datagram from source to destination, datagram format, IP datagram fragmentation, Internet Control Message Protocol, Network address translators, Routing.

Link Layer and Local Area Networks Link layer channels, data link layer, services provided by the link layer, adapters communicating, error detection and correction techniques, parity checks, multi-access protocols, channel portioning protocols, code division multiple access, random access protocols, taking turns protocols, Local Area Networks, LAN address and ARP, address resolution protocol.

References:

1. Computer networks by A.S. Tanenbaum, 3rd edition, Prentice Hall India
2. An engineering approach on computer networking by S. Keshav, Addison Wilsey.
3. Data and computer communication by W. Stalling, Macmillan Press.

Modelling and Simulation

INTRODUCTION Simulation: a tool, advantages and disadvantages of simulation, areas of application, systems and system environment, components of a system, discrete and continuous systems, discrete event system simulation.

GENERAL PRINCIPLES Concepts in discrete event simulation, time advance algorithm, manual simulation using event scheduling, basis properties and operations.

MOEDLS IN SIMULATION Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Bionomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution; Gamma distribution; Normal distribution; Weibull distribution; Triangular Distribution; Lognormal distribution, poisson process,

QUEUEING MODELS Characteristics of queuing systems, the calling population, system capacity, arrival process, service mechanism, queuing notations, long run measures of performance of queuing systems, server utilization in G/G/1/∞/∞ queues, server utilization in G/G/C/∞/∞ queues, server utilization and system performance, costs in queuing problems, Larkovian models.
RANDOM NUMBER GENERATION Properties of random numbers, Pseudo random numbers, techniques of generating random numbers, tests of random numbers.
RANDOM VARIATE GENERATION Inverse transform technique, Direct transformation for the Normal and Lognormal distribution, Convolution Method, Acceptance rejection technique.
INPUT MODELLING AND VALIDATION Steps in the development of model, data collection, Distribution identification, Parameter estimation, Goodness of Fit Tests, selecting input models without data, verification and validation of simulation models.

References:

1. Simulation Modelling and Analysis by Law and Kelton, Mc Graw Hill, 1991
2. Simulation Model Design& execution by Fishwich, Prentice Hall, 1995
3. Discrete event system simulation by Banks, Carson, Nelson and Nicol

Mechanical Vibrations

Course Objectives:

1. To learn importance of vibration in machine design and dynamic stress analysis.
2. To learn how to present dynamic stress analysis
3. To learn how to present dynamic stress related failure in machines and structure
4. To learn vibration measurement in industrial machines.

Course Outcomes: Upon completion of this course, student will have

1. Appreciation for the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions
2. Ability to analyze the mathematical model of a linear vibratory system to determine its response
3. Ability to obtain linear mathematical models of real life engineering systems
4. Ability to use Lagrange's equations for linear and nonlinear vibratory systems
5. Ability to determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation
6. General notion on frequency and time response of vibratory systems

Syllabus:

Introduction to vibration in mechanical and structural systems. Discrete system modeling. Hamilton's principle and Lagrange's equation. Free and forced vibration response of single degree of freedom system with and without damping under harmonic excitation. Discussion on various types of damping; viscous, coulomb, hysteretic etc. Forced response under periodic excitation and transient response through Duhamel's integral. Concept of response spectrum.
Rotor whirling and critical speed. Vibration isolation and transmissibility ratio. Vibration isolation in automobiles. Dynamic vibration absorber. Torsional vibration in rotors. Numerical simulation in Cosmo-Kgp using Bond graph modeling and in Simulink of Matlab. Modeling of multi degree of freedom systems. Determination of natural frequencies using matrix iteration and deflation technique. Concept of mode shapes and orthogonality principle. Rayleigh's quotient. Free and forced response through modal analysis. Vibration of continuous systems. Longitudinal vibration of rods, transverse vibration of beams and torsional vibration of shafts. Determination of natural frequencies and mode shapes under various boundary conditions. Introduction to FEM modeling of continuous systems. Free and forced response through modal analysis. Introduction and distinguishing characteristics of nonlinear vibration. Phase plane, equilibrium points and limit cycles. Random vibration, correlation and spectral density functions. Vibration measurement parameters and procedures. Vibration transducers and instruments. Source of vibration in Machineries. Role of vibration measurement and analysis in machine design and machine condition monitoring.

References:

1. Rao, Gupta, “Theory & practice of Mechanical vibration,” 3rd Edition, NewAge Publication.
2. Thomson, “Theory of Vibration,” 3rd Ed , CBS publication
3. Meirovitch, “ Elements of Vibration analysis”, 2nd Ed, McGraw Hill
4. Timoshenko, “Vibration Problems in Engineering,” 5th Ed, John Willey & Sons
5. S. S. Rao , “Mechanical Vibration”, Fourth Edition, Pearson Education

Fracture Mechanics and Non Destructive Testing

Course Objectives:

1. To know characteristics of basic mechanics of crack propagation and fracture phenomenon
2. Design the parts from fracture mechanics point of view by selecting proper materials and geometric features.
3. To Damage tolerance design of the components

Course Outcomes:

Upon completing this course,

1. Student will have knowledge of basic crack growth mechanism.
2. Student will select proper design based on fracture mechanics.
3. Student will be able to estimate the safe life design product.
4. Students will be able to get the knowledge of different NDT testing.

Syllabus:

Introduction to fatigue and fracture mechanics, ductile and brittle fractures. Linear elastic fracture mechanics (LEFM) and Elasto plastic fracture mechanics (EPFM) approach. Crack propagation energy release rate, Fracture behaviour, stress intensity factor, Fracture mechanism, Failure modes Mechanism of fatigue crack initiation and propagation. Fatigue data representation, life prediction, prevention of fatigue failures, corrosion fatigue., The pattern of stress and deformation near the tip of the crack. Determination of fracture toughness, condition for the fracture, Paris equation. Fatigue and fracture safe designs. Investigation and analysis of failures. Principles of various NDT techniques, Equipment, methodology, applications and benefits of various NDT techniques such as Visual inspection and eddy current testing, Liquid penetrant testing, Magnetic particle testing, Radiographic testing and Ultrasonic testing

References:

1. P.Kumar, “Elements of Fracture Mechanics”, McGraw Hill, 2012.
2. M. Jansen, J. Zuidema, R. Wanhill, “ Fracture Mechanics” Spon Press, 2004.
3. T.L. Anderson, “Fracture Mechanics:- Fundamentals and Application”, Taylor and Francis, 2005.
4. R.W. Hetzberg, “ Deformation and fracture mechanics of engineering material”, John wiley and son, 1996.

Design for Manufacturing & Assembly

Course Objectives:

1. To know characteristics of basic manufacturing processes and their capabilities.
2. Select appropriate materials, processes and features for various design requirements.
3. Design products which are suitable for manufacturing.
4. Evaluate the design for available manufacturing alternatives.

Course Outcomes: Upon completing this course:

1. Student will have knowledge of basic manufacturing processes and their capabilities.
2. Student will select appropriate material, process and features for a design.
3. Student will design products which are easy for assembly & manufacturing.
4. Student will evaluate the design for alternatives of manufacturing.

Syllabus:

Introduction – Definition, History, Advantages and Impact . Selection of materials and processes – General requirements, process capabilities, Systematic selection of processes and materials, design examples

Product design for manual assembly – General guidelines, systematic design for assembly, effect of various design features on manufacturing, design examples

Design for high speed automatic and robotic assembly – Design for high speed feeding and orientating, High speed inspection, Analysis of assembly, design examples.

Design for machining – Design for single point / multi point / abrasive machining, assembly of components, accuracy and surface finish, cost estimating, design examples.

Design for injection moulding – Injection moulding materials, moulding cycles, estmation of optimum number of cavities, design examples.
Design for sheet metal working – Dies and Press working, Press selection, Design rules, Design for sand casting, die casting, investment casting – Materials, Basic characteristics of process and mould features, cost estimating, design rules for different castings.
Design for forging – characteristics, cost estimation and design rules.

Reference Books/Material:

1. Boothroyd, G., Dewhurst, P., Knight, W. A. "Product Design for Manufacturing and Assembly", Third Edition, CRC Press, 2011.
2. Allen, C. W., "Simultaneous Engineering -Integrating Manufacturing and Design", Society of Manufacturing Engineers, Nov. 1990.
3. James Bralla, "Design for Manufacturability Handbook" McGraw Hill, 2004.
4. Anderson, D.M., "Design for manufacturability & concurrent engineering: how to design for low cost, design in high quality, design for lean manufacture, and design quickly for fast production," CIM press, 2nd Edition, 2010.

Rapid Prototyping and Manufacturing

INTRODUCTION: CAD-CAM and its integration, Development of CAD CAM. The importance of being Rapid, The nature of RP/T. The state of RP/T industry. Rapid Prototyping Defined. Time compression Technologies, Product development and its relation ship with rapid prototyping.
PROCESS CHAIN FOR RAPID PROTOTYPING: Data Preparation (Pre-processing), Part Building, Post Processing. CAD Model Preparqtion, Reverse Engineering and CAD model, Digitizing Techniques: Mechanical Contact Digitizing, Optical Non-contact Measurement, CT Scanning Method, Data Processing for Surface Reconstruction.
Data interface for Rapid Prototyping: STL interface Specification, STL data generation, STL data Manipulation, Advantages and limitations of STL file format. Open files. Repair of STL files. Alternative RP interfaces.
Part orientation and support generation: Factors affecting part orientation, various models for part orientation determination, the function of part supports, support structure design, Automatic support structure generation.
Model Slicing and Contour Data organization: Model slicing and skin contour determination, Identification of external and internal contours, Contour data organization, Direct and adaptive slicing: Identification of peak features, Adaptive layer thickness determination, Skin contour computation. Tool path generation.
Part Building: Recoating, parameters affecting part building time, part quality.
Post Processing: Part removal, finishing, curing.
Other issues: Shrinkage, Swelling, Curl and distortion, Surface Deviation and accuracy, Build Style Decisions,
RAPID PROTOTYPING MACHINES: Classification, Description of RP Machines: SLA, SLS, FDM, 3D Printing, LOM, SDM, Contour Crafting, 3D Welding, etc., CNC-machines and hybrid systems.
RAPID TOOLING AND MANUFACTURING: Classification of RT Routes, RP of Patterns, Indirect RT: Indirect method for Soft and Bridge Tooling, Indirect method for Production Tooling, Direct RT: Direct RT method for Soft and Bridge Tooling, Direct methodfor Production Tooling, Other RT Approaches. Rapid Manufacturing: Methods, limitations.
APPLICATION OF RP: Heterogeneous objects, Assemblies, MEMES and other small objects, Medicine, Miscellaneous areas including art.

References:

1. Bjorke, Layer Manufacturing, Tapir Publisher. 1992.
2. Jacobs, PF (Ed), Rapid Prototyping and Manufacturing, Society of Manuf. Engrs, 1992.
3. Burns, M., Automated Fabrication: Improving Productivity in Manufacturing, 1993.
4. Jacobs, P.F. (Ed.), Stereolithography and Other RP&M Technologies: From Rapid Prototyping to Rapid Tooling, Society of Manuf. Engrs. NY, 1996.

5. Chua C. k. and L. K. Fai, Rapid Prototyping: Principles and Applications in Manufacturing.
6. Gibson, I. (Ed.), Software Solutions for Rapid Prototyping, Professional Engineering Publications, London., 2002.

Product Design & Development

Course Objectives:

1. To understand the relationship of art and science to design
2. To develop proficiency in design skills and methodologies
3. To gain first-hand experience of the design process in the context of a 'real', open-ended multidisciplinary design project
4. To work effectively and professionally in a team while executing a design project
5. To apply engineering analysis tools in the design process
6. To understand the holistic context of design, including global, societal, ethical, economic and environmental concerns
7. To improve proficiency in professional communication skills

Course Outcomes: Upon completing this course,:

1. Students should be able to design a product using computer aided design.
2. Students should be able to carry out product development and planning process.
3. Students should be able to understand the concept of prototyping.

Syllabus:

Definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle.

Product Design Practice and Industry: Introduction, Product Strategies, Time to Market, Analysis of the Product, The Three S's Standardization, Renard Series (Preferred Numbers) Simplification, The Designer and His Role, The Designer: Myth and Reality, The Industrial Design Organization, Basic Design Considerations, Problems faced by Industrial Designer, Procedure adopted by Industrial Designers, Types of Models designed by Industrial Designers What the Designer contributes, Role of Aesthetics in' Product Design, Functional Design Practice.

Economic Factors Influencing Design :Product Value, Design for Safety, Reliability and Environmental Considerations Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Break-even Analysis, Economics of a New Product Design (Samuel Eilon Model).

Human Engineering Considerations in Product Design: Introduction, Human Being as Applicator of. Forces, Anthropometrics: Man as Occupant of Space The Design of Controls, The Design of Displays, Man/Machine Information Exchange.

Reference Books/Material:

Chitale, Gupta, " Product Design & Manufacturing", 2nd Ed 2002, Prentice Hall of India

Machine Condition Monitoring

Course Objectives:

1. To know various methods of condition monitoring
2. To know and use various instruments used for condition monitoring
3. To process and analyze machine signal for diagnosis
4. To apply modern methods for machine condition monitoring

Course Outcomes:

At the conclusion of this course, it is expected that student will be able to:

1. Know basic machine problems and their monitoring methods.
2. Use of appropriate parameter for monitoring
3. Use of modern tools for monitoring
4. Draw charts, graphs, etc. to indicate machine status

Syllabus:

Introduction: Definition, Need and relevance to maintenance, Different techniques and their practical applications. Vibration and AE based condition monitoring, Measurement of vibration and acoustic emission – Measuring parameters, Transducers, selection of appropriate parameters and transducers Data acquisition and signal processing: A/D converters, Filters, Time & Frequency domain analysis, Analysis of stationary and non-stationary signals- FFT and Wavelet Transform in machine condition monitoring. Analysis and interpretation of vibration and AE data, trending, indices for condition monitoring, their

significance, normal and fault indicating values, ISO and other standards, Oil & wear debris analysis and ferrography: Principles, methods and instruments for wear debris analysis and ferrography. Condition monitoring of various machine components and machines like bearings, gears, pumps, compressors, turbines, machine tools, cutting tools, etc. to diagnose various defects. Machinery prognostics, prediction of failures, concept of integrated analysis

Reference Books:

1. Randall R. B., " Vibration Based Condition Monitoring," Ch.1, Ch. 2, Ch 3, Wiley, New Delhi, 2010.
2. Cempel C., "Ellis Horwood Series in Mechanical Engineering, Vibroacoustic Condition Monitoring," pp. 1 – 43, Michigan
3. Piersol A. and Paez T , "Harris' Shock and Vibration Handbook," Mc-Graw Hill, 2010
4. Alan Davies, "Handbook of Condition Monitoring: Techniques & Methodology," Chapman & Hall, London , 1998.

Mini project

Course Outcomes:

At the end of the course:

1. Students will get an opportunity to work in actual industrial environment if they opt for internship.
2. In case of mini project, they will solve a live problem using software/analytical/computational tools.
3. Students will learn to write technical reports.
4. Students will develop skills to present and defend their work in front of technically qualified audience.

Syllabus:

Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Lab Practice III and IV

FINITE ELEMENT METHOD LAB

Course Objectives:

1. Equip the students with the Finite Element Analysis fundamentals,
2. Enable the students to formulate the design problems into FEA,
3. Enable the students to perform engineering simulations using Finite Element Analysis software (ANSYS & LSDYNA).
4. Enable the students to understand the ethical issues related to the utilization of FEA in the industry

List of Experiments:

Dissertation Phase-I

Course Outcomes:

At the end of the course:

1. Students will be exposed to self-learning various topics.
2. Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
3. Students will learn to write technical reports.
4. Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.

Guidelines:

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

Dissertation Phase- II

Course Outcomes:

At the end of the course:

1. Students will be able to use different experimental techniques.
2. Students will be able to use different software/ computational/analytical tools.
3. Students will be able to design and develop an experimental set up/ equipment/test rig.
4. Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
5. Students will be able to either work in a research environment or in an industrial environment.
6. Students will be conversant with technical report writing.
7. Students will be able to present and convince their topic of study to the engineering community.

Guidelines:

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

OPEN ELECTIVES

Business Analytics

Course objective

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Unit1:

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit 2:

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.

Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit 3:

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit 4:

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5:

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit 6:

Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Course outcomes

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

Reference:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.
2. Schniederjans, Christopher M. Starkey, Pearson FT Press.
3. Business Analytics by James Evans, persons Education.

Industrial Safety

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Operations Research

Course Outcomes:

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

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

Syllabus Contents:

Unit 1:
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit 3:
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5
Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Cost Management of Engineering Projects

Introduction and Overview of the Strategic Cost Management Process
Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Composite Materials

UNIT–I: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Waste to Energy

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT 1 and 2

English for Research Paper Writing

Course objectives:

Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

Ensure the good quality of paper at very first-time submission		
Syllabus		
Units	**CONTENTS**	**Hours**
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Disaster Management

Course Objectives: -Students will be able to:

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Syllabus

Uni ts	CONTENTS	Hours
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	**Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	**Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4

6	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	4

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Syllabus

Unit	***Content***	***Hours***
1	Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences	8
2	Order Introduction of roots Technical information about Sanskrit Literature	8
3	Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

VALUE EDUCATION

Course Objectives

Students will be able to

1.Understand value of education and self- development

2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Unit	***Content***	***Hours***
1	▯ Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. ▯ Moral and non- moral valuation. Standards and principles. ▯ Value judgements	4
2	▯ Importance of cultivation of values. ▯ Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. ▯ Honesty, Humanity. Power of faith, National Unity. ▯ Patriotism.Love for nature ,Discipline	6
3	▯ Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. ▯ Punctuality, Love and Kindness. ▯ Avoid fault Thinking. ▯ Free from anger, Dignity of labour. ▯ Universal brotherhood and religious tolerance. ▯ True friendship. ▯ Happiness Vs suffering, love for truth. ▯ Aware of self-destructive habits. ▯ Association and Cooperation. ▯ Doing best for saving nature	6
4	▯ Character and Competence –Holy books vs Blind faith. ▯ Self-management and Good health. ▯ Science of reincarnation. ▯ Equality, Nonviolence ,Humility, Role of Women. ▯ All religions and same message. ▯ Mind your Mind, Self-control. ▯ Honesty, Studying effectively	6

Suggested reading

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes

Students will be able to

1.Knowledge of self-development

2.Learn the importance of Human values

3.Developing the overall personality

CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus

Units	Content	Hours
1	**History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)	4
2	**Philosophy of the Indian Constitution:** Preamble Salient Features	4
3	**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	4
4	**Organs of Governance:** Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers	4

	□ Judiciary, Appointment and Transfer of Judges, Qualifications □ Powers and Functions	
5	□ **Local Administration:** □ District's Administration head: Role and Importance, □ Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation. □ Pachayati raj: Introduction, PRI: Zila Pachayat. □ Elected officials and their roles, CEO Zila Pachayat: Position and role. □ Block level: Organizational Hierarchy (Different departments), □ Village level: Role of Elected and Appointed officials, □ Importance of grass root democracy	4
6	□ **Election Commission:** □ Election Commission: Role and Functioning. □ Chief Election Commissioner and Election Commissioners. □ State Election Commission: Role and Functioning. □ Institute and Bodies for the welfare of SC/ST/OBC and women.	4

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

Pedagogy Studies

Course Objectives:

Students will be able to:

4. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
5. Identify critical evidence gaps to guide the development.

Syllabus

Units	Content	Hours
1	□ **Introduction and Methodology:** □ Aims and rationale, Policy background, Conceptual framework and terminology □ Theories of learning, Curriculum, Teacher education. □ Conceptual framework, Research questions**.** □ Overview of methodology and Searching.	4
2	□ Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. □ Curriculum, Teacher education.	2

3	Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.	4
4	Professional development: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes	4
5	**Research gaps and future directions** Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.	2

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Stress Management by Yoga

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit	***Content***	***Hours***
1	Definitions of Eight parts of yog. (Ashtanga)	8
2	Yam and Niyam. Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
3	Asan and Pranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types of pranayam	8

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

Personality Development through Life Enlightenment Skills

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue) Verses- 52,53,59 (dont's) Verses- 71,73,75,78 (do's)	8
2	Approach to day to day work and duties. Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.	8
3	Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	8

Suggested reading

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to
1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.