Syllabus of B. Tech. Mechanical Engineering (Design and Manufacturing) + M. Tech. Advanced Manufacturing (MFD) for 1st and 2nd Semesters

(According to 22nd and 23rd Senate meeting minutes)

Course Title	Calculus	Course No *(will be assigned)*				
Specialization	Mathematics	Structure (LTPC)	3	0	0	3
Offered for	UG& DD	Status	Core ■		Elective ☐	
Faculty		Type	New ☐		Modification ☐	
Pre-requisite		To take effect from				
Submission date	21/07/2014	Date of approval by Senate				
Objectives	The course will introduce the student to basic concepts in Calculus such as convergence, differentiation & integration and its applications.					
Contents of the course	Limit and Continuity of functions defined on intervals, Intermediate Value Theorem, Differentiability, Rolle's Theorem, Mean Value Theorem, Taylor's Formula (5) Sequences and series (7) Definite integral as the limit of sum – Mean value theorem – Fundamental theorem of integral calculus and its applications (9) Functions of several variables – Limit and Continuity, Geometric representation of partial and total increments Partial derivatives – Derivatives of composite functions (8) Directional derivatives – Gradient, Lagrangemultipliers – Optimization problems (7) Multiple integrals – Evaluation of line and surface integrals (6)					
Textbook	1. Thomas. G.B, and Finney R.L, Calculus, Pearson Education, 2007.					
References	1. Piskunov. N, Differential and Integral Calculus, Vol. I & II, Mir. Publishers, 1981. 2. Kreyszig. E, Advanced Engineering Mathematics, Wiley Eastern 2007. 3. J Hass, M D Weir, F R Giordano, Thomas Calculus, 11th Edition, Pearson.					

Course Title	Differential Equations	Course No *(will be assigned)*				
Specialization	Mathematics	Structure (LTPC)	3	0	0	3
Offered for	UG & DD	Status	Core ▬		Elective	
Faculty		Type	New		Modification ▬	
Pre-requisite		To take effect from				
Submission date	21/07/2014	Date of approval by Senate				
Objectives	To provide an exposure to the theory of ODEs & PDEs and the solution techniques.					
Contents of the course	Linear ordinary differential equations with constant coefficients, method of variation of parameters – Linear systems of ordinary differential equations (10) Power series solution of ordinary differential equations and Singular points Bessel and Legendre differential equations; properties of Bessel functions and Legendre Polynomials (12) Fourier series (6) Laplace transforms elementary properties of Laplace transforms, inversion by partial fractions, convolution theorem and its applications to ordinary differential equations (6) Introduction to partial differential equations, wave equation, heat equation, diffusion equation (8)					
Textbooks	1. Simmons. G.F, Differential Equations, Tata McGraw Hill, 2003. 2. Kreyszig. E, Advanced Engineering Mathematics, Wiley, 2007.					
References	1. William. E. Boyce and R. C. Diprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 8 Edn, 2004. 2. Sneddon. I, Elements of Partial Differential Equations, Tata McGraw Hill, 1972. 3. Ross. L.S, Differential Equations, Wiley, 2007. 4. Trench, W, Elementary Differential Equations, http://digitalcommons.trinity.edu/mono					

Course Title	Engineering Mechanics	Course No *(will be assigned)*				
Specialization	Physics	Structure (LTPC)	3	0	0	3
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New ■		Modification □	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	In this course, students will learn a basic knowledge of forces, moments on the components of a structure of engineering problems. They will also learn to analyze: forces and moments on a static rigid body, moments on/between multiple static rigid bodies and internal forces/moments in a static rigid body. This course will help the student to develop the ability visualize physical configurations in terms of real materials constraints which govern the behavior of machine and structures.					
Contents of the course	Equivalent force systems; free-body diagrams; degrees of freedom; equilibrium equations; analysis of determinate trusses and frames; properties of surfaces - friction; (10) Particle Dynamics: equations of motion; work-energy and impulse-momentum principles;. Generalized coordinates; Lagrangian mechanics. (12) Rigid body dynamics: plane kinematics and kinetics of rigid bodies including work-energy and impulse-momentum principles; single degree of freedom rigid body systems (10) Stresses and strains (including thermal starin); principal stresses and strains; generalized Hooke's Law; free vibration of single degree-of freedom systems. (10)					
Textbook	1. F. Beer. R. Johnston, Vector mechanics for engineers: statics and dynamics. Tata McGraw-Hill, 2010.					
References	1. Meriam. J. L and Kraige. L. G, Engineering Mechanics, Vol. I – Statics, Vol 2: Dynamics, 2007. 2. H. Goldstein , Classical Mechanics, Pearson Education, 2011. 3. Kittle. C, Mechanics – Berkley Physics Course, Vol. 1, Tata McGraw Hill, 2008.					

Course Title	Engineering Electromagnetics	Course No *(will be assigned)*				
Specialization	All Branches of UG	Structure (LTPC)	3	0	0	3
Offered for	UG	Status	Core ■		Elective ☐	
Faculty	Tapas Sil	Type	New ■		Modification ☐	
Pre-requisite	-----	To take effect from				
Submission date	21/07/2014	Date of approval by Senate				

Objectives

The objective of this course is to give an idea how the electromagnetic wave behaves. This also provides an understanding of theories of electrostatics, magnetism and electrodynamics with their applications. It will enhance the problem solving capacity of the student.

Contents of the course

Vectors - an introduction; Unit vectors in spherical and cylindrical polar co-ordinates; Concept of vector fields; Gradient of a scalar field; flux, divergence of a vector, Gauss's theorem, Continuity equation; Curl –rotational and irrotational vector fields, Stoke's theorem. (12)

Electrostatics:
Electrostatic potential and field due to discrete and continuous charge distributions, boundary condition, Energy for a charge distribution, Conductors and capacitors, Laplaces equation Image problem , Dielectric polarization, electric displacement vector, dielectric susceptibility , energy in dielectric systems. (10)

Magnetostatics:
Lorentz Force law Biot-Savart's law and Ampere's law in magnetostatics, Divergence and curl of B, Magnetic induction due to configurations of current-carrying conductors, Magnetization and bound currents, Energy density in a magnetic field Magnetic permeability and susceptibility. (10)

Electrodynamics:
Electromotive force, Time-varying fields, Faradays' law of electromagnetic induction,
Self and mutual inductance, displacement current, Maxwell's equations in free space. Boundary condition, propagation in linear medium. Plane electromagnetic waves—reflection and refraction, electromagnetic energy density, Poynting vector. (10)

Textbook

1. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McFraw Hill Education Pvt. Ltd, 2006.

References

1. Grifiths. D. J, Introduction to Electrodynamics, Prentice Hall, 2007.
2. Purcell. E.M, Electricity and Magnetism Berkley Physics Course, V2, Tata McGraw Hill, 20 08.
3. Feynman. R.P, Leighton. R.B, Sands. M, The Feynman Lectures on Physics, Narosa Publish ing House, Vol. II, 2008. Hill, 2008.
4. G. B. Arfken, H. J. Weber and F. E. Harris, Mathematical Methods for Physicists, Academic Press, 2013.

Course Title	Computational Engineering	Course No *(will be assigned)*				
Specialization	Computer Engineering	Structure (LTPC)	3	0	0	3
Offered for	UG & DD	Status	Core ■		Elective ☐	
Faculty		Type	New ☐		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objective	The course introduces students to computer systems and organization and a higher level language (C) to communicate with the system. The student would be equipped with basic skillset required to interact with the system / create applications supporting a command line interface.					
Contents of the course	Introduction to computers & breadth scope in engineering – Computer organization basics – Problem solving strategies – Higher level languages – Program design and development – Phases of program development - Basic programming constructs in C – Data types in C – Input output statements – Operators, control structures in C - Sequential, Selection, Repetition (12) Functions in C –Function declaration, definition – Built and user defined functions –Storage classes and scope –Recursive functions – Arrays in C – multidimensional arrays-String manipulations – Library support (14) Introduction to pointers – References – Pointer Arithmetic – Formatted input output – User defined data types – File processing in C - Sequential & Random - Dynamic Memory Allocation – Command Line Arguments – Usable CLI based applications - Non linear equations– Bisection, Newton raphson methods. (16)					
Textbook	1. Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 7th Edn, 2012.					
References	1. Kernighan, Ritchie D, The C Programming Language, Prentice Hall, 2 Edn. 2. Chapra S.C and Canale R.P, Numerical Methods for Engineers, McGraw Hill, 2006.					

Course Title	Basic Electrical and Electronics Engineering	Course No *(will be assigned)*					
Specialization		Structure (LTPC)	3	0	0	3	
Offered for	UG/DD	Status	Core ■		Elective □		
Faculty		Type	New ■		Modification □		
Pre-requisite		To take effect from					
Submission date	21/07/2014	Date of approval by Senate					

Objectives	Learn how to develop and employ circuit models for elementary electronic components and circuit analysis, network theorems, role of power flow and energy storage in electronic circuits;step and sinusoidal-steady-state response, AC signal powers, three phase circuits and loads, and brief introduction to diodes and BJTs.
Contents of the course	Electrical circuit elements: voltage and current sources, R,C,L,M,I,V, linear, non linear, active and passive elements, inductor current and capacitor voltage continuity, Kirchhoff's laws, Elements in series and parallel, superposition in linear circuits, controlled sources, energy and power in elements, energy in mutual inductor and constraint on mutual inductance (7) Network analysis: Nodal analysis with independent and dependent sources, modified nodal analysis, mesh analysis, notion of network graphs, nodes, trees, twigs, links, co-tree, independent sets of branch currents and voltages (6) Network theorems: voltage shift theorem, zero current theorem, Tellegen's theorem, reciprocity, substitution theorem, Thevenin's and Norton's theorems, pushing a voltage source through a node, splitting a current source, compensation theorem, maximum power transfer (8) RC and RL circuits: natural, step and sinusoidal steady state responses, series and parallel RLC circuits, natural, step and sinusoidal steady state responses (5) AC signal measures: complex, apparent, active and reactive power, power factor (2) Introduction to three phase supply: three phase circuits, star-delta transformations, balanced and unbalanced three phase load, power measurement, two wattmeter method (5) Semiconductor diodes and application: PN diodes, rectifiers and filters, clipping and clamping circuits, voltage multiplier circuits (5) Bipolar Junction Transistors: DC characteristics, CE, CB, CC configurations, biasing, load line (4)
Textbook	1. Hayt. W. W, Kemmerly. J.E, and Durbin. S.M, Engineering Circuits Analysis, Tata McGraw Hill, 2008. 2. Boylestad R. &Nashelsky L., Electronic Devices & Circuit Theory, Pearson Education, 2009
References	1. Hughes Edward, Electrical & Electronic Technology, Pearson Education, 2007. 2. Hambley. A, Electrical Engineering Principles and Applications: International Version, Pearson Education, 4 Edn, 2007. 3. Alexander.C. K. & Mathew. N. O. Sadiku, Fundamentals of Electrical circuits, Tata McGraw Hill, 2008.

Course Title	Science and Engineering of Materials	Course No *(will be assigned)*				
Specialization		Structure (LTPC)	3	0	0	3
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New ■		Modification □	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	The objective of this course is to provide a basic conceptual understanding of crystal structure and its relevance in classification of different materials based on their properties. The engineering of structure of different materials and development of natural and man-made materials with their applications would also be discussed.					
Contents of the course	Crystal structure, defects, crystallographic planes, directions, slip, deformation mechanical behaviour, and strengthening mechanisms. (10) Electrical, electronic, magnetic properties of materials, property management and case studies alloys, steel, aluminum alloys. (6) Polymeric structures, polymerization, structure property relationships, processing property relationships,. (6) Natural and manmade composites, processing, properties, applications (6) Ceramics, manufacturing and properties, applications (4) Environmental degradation of engineering materials (4) Introduction to Nano, Bio, Smart and Functional materials. (4)					
Textbook	1. Callister's Materials Science and Engineering, 2nd ED, Adapted by R Balasubramaniam, 2010, ISBN-13: 978-8126521432, Wiley India Ltd. 2. V Raghavan, "Materials Science and Engineering: A First Course, 5th Ed, 2004, PHI India					
References	1. Donald R. Askeland K Balani, "The Science and Engineering of Materials," 2012, Cengage Learning					

Course Title	Concepts in Engineering Design	Course No *(will be assigned)*				
Specialization	Design	Structure (LTPC)	3	0	0	3
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	The purpose of this course is to introduce to the undergraduate student the fundamental principles of Engineering Design which is very important and relevant in the context of todays engineering professionals. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines. Case studies from field situations and real products will be used to illustrate these principles.					
Contents of the course	Design Conceptualization and Philosophy, Original, Adaptive, Variant and Re-Design, Evolution of Concept, Need for Systematic design Past methods of and design Product life cycle, Innovation, Types of innovation Needs and opportunities, Vision and Mission of a concept, Type of needs, Technology S - curve, Need analysis, market analysis and competitive analysis, Kano Diagrams, SWOT analysis Conceptualization techniques – Idea generation – ideation, brainstorming, Trigger session Brain writing, Mind maps, SCAMPER, TRIZ, Biommicry, Shape mimicry, Familiarity Matrix Concepts screening, Concept testing - exploratory tests, Assessment tests , Validation tests Comparison tests – Case studies Organization of design concept and design methods, Engineering Design - Descriptive and prescriptive model, Design decisions and development of design Group work and case studies					
Textbook	1. Otto. K and Wood, K, Product Design, Pearson Education, 2001. 2. Pahl. G and Beitz. G, Engineering Design, Springer, 1996					
References	1. Ullman. D. G, The Mechanical Design Process, McGraw- Hill, 1997.					

Course Title	English for Communication	Course No *(will be assigned)*				
Specialization	Humanities	Structure (LTPC)	2	0	0	2
Offered for	UG and DD	Status	Core ■		Elective □	
Faculty		Type	New ■		Modification □	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	Read a given text at a reasonable speed - Comprehend and critically read the text - Understand and use lexis accurately and appropriately - Listen to various types of spoken discourses understand, analyse and apply the same Listen and comprehend lectures and speeches - Speak coherently and fluently on a given topic Speak with confidence and present point of view - Write fluently and coherently on a given topic - Write various types of tasks short and long - Use lexis appropriate to the task while writing - Use accurate grammatical structures while speaking and writing - Give Power Point presentations. Use idioms appropriately.					
Contents of the course	Listening – Listening comprehension. Listen to various types of spoken discourses understand, analyse and apply the same. Listen and comprehend lectures and speeches. (3) Speaking – Organization, articulation and correctness. Speak with confidence and present a point of view. Speak coherently and fluently on a given topic. (8) Reading – Comprehend and critically read the text. Read a given text at a reasonable speed (5) Writing – Memos, letters, reports, reviews and writing fluently and coherently on a given topic. Write various types of tasks; short and long. (7) Presentation Skills – Oral presentation using Power Point. Study Skills – Dictionary, thesaurus & reference Structure of English – Remedial grammar/ Grammar for Communication (5)					
Textbook	1. Shreesh Choudhry, Devaki Reddy , Technical English, Macmillan Publishers,2009.					
References	1. Martin Hewings , Advanced English Grammar, Cambridge University Press,2007. 2. V. Saraswathi, Leena Anil, Manjula Rajan , Grammar for Communication,2012. 3. Thomson and Martinet , Practical English Grammar, Oxford University Press, 1986. 4. 4. Leech, Geoffrey & Jan Svartvik, A Communicative Grammar of English, Longman,2003					

Course Title	Design History	Course No *(will be assigned)*				
Specialization	Design	Structure (LTPC)	2	0	0	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	This course will help students to (a) understand the evolution and application of the concept of Design in everyday life of people (b) appreciate its role in national and international economic and social systems, and (c) analyze the emerging designs from a societal perspective.					
Contents of the course	Definition of Design; Origin of designers; Historical context of design and designers. Designers and designed products: Art, design and technology - Select International and Indian designers. Industrial Revolution: Mass production, Birth of Modern architecture, International Style, The modern home. Craft and Design: Type forms; William Morris and Arts and Craft Movement; Shantiniketan. Design movements: Art Nuoveau; Art Deco, Werkbund; Bauhaus; De Stijl. Changing values: Information Revolution: Impact of technology, industrialization and globalization on design: kitsch, pastiche, 'retro'; Shopping malls. Design Studies: Materials and techniques; Chinese ceramics; Typology; Content analysis : Anthropology / sociology; Nationalist and global trends in Design; Nationalist Design; Global trends and global identity; Nostalgia, Heritage and Design;					
Textbook	1. Conway Hazel, Design History – A Students' Handbook, Routledge: London, 1987.					
References	1. Raizman David, History of Modern Design, Graphics and Products since the Industrial Revolution. Laurence King Publishing :London, 2003 2. Walker John. A, Design History and History of Design. Pluto Press: London, 2003. 3. Woodham Jonathan M, Twentieth Century Design, Oxford University Press: Oxford, 2003.					

Course Title	Earth, Environment & Design	Course No *(will be assigned)*				
Specialization	Interdisciplinary	Structure (LTPC)	2	0	0	2
Offered for	UG	Status	Core ■		Elective □	
Faculty		Type	New ■		Modification □	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	The course aims to provide an understanding of systems and processes in aquatic and terrestrial environments, and to explore changes in the atmosphere, lithosphere, hydrosphere, biosphere, and the evolution of organisms, since the origin of life on earth.					
Contents of the course	Introduction to environment and ecology – Ecosystems – Principles concepts, components and function Atmospheric, aquatic and terrestrial ecosystems – Biogeochemical cycles and limiting factor concepts –Impacts of natural and human activities on ecosystems Environmental policies, acts and standards – Sustainable development and environmental impact assessment – Institutional frame work and procedures for EIA Methods for impact identification-matrices – Networks and Check lists – Environmental settings, indices and indicators Prediction and assessment of the impacts on air, water, land, noise and biological environments – Assessment of impacts of the cultural, socioeconomic and ecosensitive environments Mitigation measures, economic evaluation – Public participation and design making –Preparation of Environmental statement					
Textbook	1. Rubin. E. S, Introduction to Engineering and the Environment, McGraw Hill, 2000. 2. Masters. G. M., Introduction to Environmental Engineering & Science, Prentice Hall,1997.					
References	1. Henry. J. G, and Heike, G. W, Environmental Science & Engineering, Prentice Hall International, 1996. 2. Dhameja. S. K, Environmental Engineering and Management, S. K. Kataria and Sons, 1999. 3. Shyam Divan and Armin Rosancranz, Environmental Law and Policy in India, Cases, Materials and Statutes, Oxford University Press, 2001.					

Course Title	Professional Ethics for Engineers	Course No *(will be assigned)*				
Specialization	Management	Structure (LTPC)	2	0	0	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	In this course, students will be aware on Human Values and Ethics in Professional life. They will understand social responsibility of a professional person especially of an engineer. They will learn the techniques and logical steps to solve ethical issues and dilemmas.					
Contents of the course	Professionalism and Ethics: Profession and occupation, Qualities of a professional practitioner, Variety of ethics and moral issues, moral dilemmas; Kohlberg's theory - Gilligan's theory of moral development - consensus and controversy. Values- concept of intrinsic good, instrumental good and universal good. Kant's theory of good action and formula for universal law of action. Codes of ethics for engineers: need and scope of a code of ethics; Ethics and Law (10) Understanding Ethical Problems: ethical theories – utilitarianism, cost-benefit analysis, Duty ethics - Right ethics and virtue ethics. Applications for various case studies. Ethical Problem Solving Techniques: issues-factual, conceptual and moral; Bribery and acceptance of gifts; Line drawing and flow charting methods for solving conflict problem. (09) Risk, Safety and Accidents: Safety and risk, types of risk, types of accidents and how to avoid accidents. Rights and Responsibilities of an Engineer: Professional responsibility, professional right and whistle blowing. Ethical Issues in Engineering Practice: environmental ethics, computer ethics, ethics and research. (09)					
Textbook	1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004					
References	1. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000. 2. Velasquez. M. G, Business Ethics and Cases, 5 Edn, Prentice Hall, 2002. 3. Sekha. R.C, Ethical Choices in Business Response, Sage Publication, 2002. 4. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, 1996.					

Course Title	Engineering Skills Practice	Course No *(will be assigned)*				
Specialization	Interdisciplinary	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite	----	To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	The objective of this course is to give an exposure on the basic practices followed in the domain of mechanical, electrical, electronics and communication engineering. The exercises will train the students to acquire skills which are very essential for the engineers through hands-on sessions.					
Contents of the course	Experiments will be framed to train the students in following common engineering practices: Basic manufacturing processes: Fitting – Drilling & tapping – Material joining processes – PCB making – Assembling and testing – Electrical wiring. Familiarization of electronic components by Nomenclature, meters, power supplies, function generators and Oscilloscope – Bread board assembling of simple circuits: IR transmitter and receiver – LED emergency lamp – Communication study: amplitude modulation and demodulation – PCB: designing and making of simple circuits – Soldering and testing of electronic components and circuits –Various types of Domestic wiring practice: Fluorescent lamp connection, Staircase wiring – Estimation and costing of domestic and industrial wiring – power consumption by Incandescent, CFL and LED lamps.					
Textbook	1. Uppal S. L., "Electrical Wiring & Estimating", 5Edn, Khanna Publishers, 2003. 2. Chapman. W. A. J., Workshop Technology, Part 1 & 2, Taylor & Francis.					
References	1. Clyde F. Coombs, "Printed circuits hand book", 6Edn, McGraw Hill, 2007. 2. John H. Watt, Terrell Croft, "American Electricians' Handbook: A Reference Book for the Practical Electrical Man", Tata McGraw Hill, 2002.					

Course Title	Engineering Electromagnetics Practice	Course No *(will be assigned)*				
Specialization	All Branches of UG	Structure (LTPC)	0	0	3	2
Offered for	UG	Status	Core ■		Elective ☐	
Faculty	Tapas Sil	Type	New ■		Modification ☐	
Pre-requisite	---	To take effect from				
Submission date	21/07/2014	Date of approval by Senate				
Objectives	The objective of this course is to give an hand on experience how the electromagnetic wave behaves in different situations. The students will be able to relate the knowledge they have got in the theory class with their experience. This course will enhance their skill of handling instruments and the presentation of the results obtained from the experiments.					
Contents of the course	Electrical and magnetic properties of materials based on the concept of electrical polarization, magnetization of materials will be studied in various experiments. Experiments based on theconcept ofphenomena such as interference, diffraction etc. related to electromagnetic waves will be done here and these methods will be applied to measure some unknown physical quantities such as wavelength of a light, diameter of a very thin wire, very small aperture for light etc.					
Textbook	1. IIITD&M Laboratory manual for Electromagnetic Wave Practice					
References	1. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McFraw Hill Education Pvt. Ltd, 2006.					

Course Title	Computational Engineering Practice	Course No *(will be assigned)*				
Specialization	Computer Engineering	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objective	The practice course would supplement the concepts presented in COM 102 course with assignments on application use and creation using the various programming constructs supported in C language. Programming assignments employing the various constructs are used to address real life situations such as a telephone directory creation / search, student grading, etc. A demo session to highlight the usability aspect relating to software / application development shall also be included.					
Contents of the course *(With approximate break up of hours)*	Learning operating system commands - editors – compilation - Assignments on using the operating system and open office suite - Programs involving output statements, input statements and expression evaluation - Assignments covering If-then-else statement iterative statements - Programs using arrays and functions based approach – Recursion sorting (bubble Sort) on a set of integers and a set of strings and linear search over a set of integers and a set of strings - structures and files in C - Implementation of a grading system computation of e^x, sin(x) and cos(x) - Bisection and Newton Raphson methods in C.					
Textbook	1. Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 7th Edn, 2012.					
References	1. Kernighan, Ritchie D, The C Programming Language, Prentice Hall, 2 Edn 2. Chapra S.C and Canale R.P, Numerical Methods for Engineers, McGraw Hill, 2006.					

Course Title	Measurements and Data Analysis Practice	Course No *(will be assigned)*				
Specialization	Interdisciplinary	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New ■		Modification □	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	To introduce the students to different measurements techniques/instruments of data acquisition and statistical methods of data analysis. At the end of the course, the student should be able to plan/design, conduct, analyze and report the results of an experiment.					
Contents of the course	Role of Experiments and measurements: Evaluation of different measurement techniques in measurement of various physical/chemical/mechanical/electrical/thermal/environmental parameters Reporting Methodology: Collection, consolidation and reporting of the data Probability and Statistics: Presentation, analysis and interpretation of the data Uncertainty/Error Analysis: Performance evaluation and determination Signal Characterization, data acquisition and Analysis: Study of vivid waveforms and digitization process					
Textbook	1. Patrick F. Dunn, "Measurement and Data Analysis for Engineering and Science", First Edition, McGraw-Hill Book Company, 2005					
References	1. Julius S. Bendat, Allan G. Piersol, "Random Data: Analysis and Measurement Procedures", 4th Edition, Wiley, 2010 2. Anthony J. Wheeler, Ahmad Reza Ganji, "Introduction to Engineering Experimentation" 3rd Edition, Prentice Hall, 2010					

Course Title	Materials and Mechanics Practice	Course No *(will be assigned)*				
Specialization	Physics	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ☑		Elective ☐	
Faculty		Type	New ☑		Modification ☐	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	The objective of this course is to give an hand on experience with mechanical properties of an object. The students will be able to relate the knowledge they have got in the theory class with their experience. This course will enhance their skill of handling instruments and how to present the result.					
Contents of the course	Experiments here will give hand on experience of concepts of small oscillations, friction, elasticity and strength of material. Experiments will be done to measure various properties of different mechanical objects such as object such rigidity modulus, Young's modulus, radius of gyration etc. Study of material properties such as microstructure, hardness, response to tensile load and long-term constant loading etc. will also be done in various experiments.					
Textbook	1. IIITD&M Laboratory manual for Mechanics and Materials Practice					
References	1. F. Beer. R. Johnston, Vector mechanics for engineers: statics and dynamics. Tata McGraw-Hill, 2010. 2. Callister's Materials Science and Engineering, 2nd ED, Adapted by R Balasubramaniam, 2010,Wiley India Ltd.					

Course Title	Industrial Design Sketching	Course No *(will be assigned)*				
Specialization	Interdisciplinary	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ■		Elective □	
Faculty		Type	New □		Modification ■	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by Senate				
Objectives	Develop necessary artistic skills required for the engineer to make communications with the industrial designers. Train the students to make realistic sketches of concept design using the commercial concept sketching software and hardware. This course will cover the concepts in perspective projections, shading, texturing, and concepts of light, shadow, reflection and colors.					
Contents of the course	• Role and importance of sketching in industrial design (2) • Principles of perspective drawing (8) • Perspective drawing of planar and curved shapes (12) • Shading and texturing (8) • Representation of shadow and reflections (8) • Colors in Industrial design and coloring (4) • Introduction to 3D forms and form development (4)					
Textbooks	1. Thomas C Wang, Pencil Sketching, John Wiley, 2002. 2. Itten Johannes, Design and Form, John Wiley, 1975.					
References	1. Kasprin Ron, Design Media – Techniques for Water Colour, Pen and Ink Pastel and colored markers, John Wiley,1999.					

Course Title	Engineering Graphics	Course No (will be assigned)				
Specialization	Interdisciplinary	Structure (LTPC)	1	0	3	3
Offered for	UG & DD	Status	Core ☑		Elective ☐	
Faculty		Type	New ☐		Modification ☑	
Pre-requisite		To take effect from				
Submission date	March 2014	Date of approval by AAC				
Objectives	To impart the basic engineering problem solving skills and to teach the fundamentals in technical drawing. Train the students to make orthographic projections and isometric projects of objects using drawing instruments and commercial drafting software.					
Contents of the course *(With approximate break up of hours)*	• Introduction to IS code of drawing (1hr) • Construction of basic shapes (4 hrs) • Dimensioning principles (1hr) • Conventional representations (1 hr) • Orthographic projection of points, lines, planes, right regular solids and objects (17 hrs) • Section of solids and objects (4 hrs) • Isometric projection of objects (6 hrs) • Intersection of solids (4 hrs) • Development of surfaces (4 hrs)					
Textbook	1. Narayana. K.L, and Kannaiah. P, Engineering Drawing, Charaotar Publ House, 1998. 2. Bhatt. N.D, Engineering Drawing, New Age International, 2007.					
References	1. Gopalakrishnan. K.R, Engineering Drawing, Subash Stores, 2002. 2. Natarajan. K.V, A text book of Engineering Drawing, Classic Prints, 2000.					

Course Title	Design Realization	Course No *(will be assigned)*				
Specialization	Design	Structure (LTPC)	0	0	3	2
Offered for	UG & DD	Status	Core ▬		Elective ☐	
Faculty		Type	New ▬		Modification ☐	
Pre-requisite		To take effect from	August 2014			
Submission date	March 2014	Date of approval by Senate				
Objectives	In Product Realization Lab, students practice conceptualization, making of simple product and realize them.					
Contents of the Course	The students are exposed to tools and equipments to machine external appearance of products of simple shapes. Wood carving, Plastic welding and cutting, engraving, sheet metal works, wire cutting are some of the process that the students will learn and use for product realization. The students will also be exposed high end machines to realize the product during demo sessions. Few sessions will be allocated to re-design an existing simple products in terms of shape, size functionality etc.					

Syllabus of B. Tech. Mechanical Engineering (Design and Manufacturing) + M. Tech. Advanced Manufacturing (MFD) for 3rd and 4th Semesters

(According to 26th Senate meeting held on 30th June 2015)

Course Title	Linear Algebra	Course No	To be filled by the office		
Specialization	Mathematics	Structure (IPC)	3	0	3
Offered for	UG and DD	Status	Core ■	Elective ☐	
Course Objectives	To impart knowledge of basic concepts and applications of Linear Algebra				
Course Outcomes	At the end of the course, a student will be able to show that they get clear understanding of methods of Linear Algebra.				
Contents of the course *(With approximate break up of hours)*	**Linear System of Equations**: Gaussian Elimination—echelon forms—existence, uniqueness and multiplicity of solutions of linear equations. (6) **Vector Spaces**: Definition—linear dependence and independence—spanning sets, basis, and dimension—definition of a subspace—intersection and sum of subspaces—direct sums. (8) **Linear Transformations**: Definition—matrix representation of a linear transformation—change of basis—similarity transformation—invertible transformation—system of linear equations revisited—the four fundamental subspaces associated with a linear transformation. (10) **Inner Products**: Definition—induced norm—orthogonality—Gram-Schmidt orthogonalization process—orthogonal projections—unitary transformations and isometry. (8) **Eigen Decomposition**: Eigenvalues and eigenvectors—characteristic polynomials and eigen spaces—diagonalizability conditions—invariant subspaces—spectral theorem. (10)				
Textbook	1. G. Strang, "Linear Algebra and its Applications," Cengage Learning, 4th Edition, 2005. 2. D. C. Lay, "Linear Algebra and its Applications," Pearson Education, 4th edition, 2011.				
References	1. C. D. Meyer, "Matrix Analysis and Applied Linear Algebra," SIAM, 2000. 2. S. H. Friedberg, A. J. Insel, and L. E. Spence, "Linear Algebra," Pearson Education, 4th Edition, 2002.				

Course Title	Systems Thinking for Design	Course No	To be filled by the office		
Specialization	Design	Structure (IPC)	2	0	2
Offered for	UG and DD	Status	Core ■	Elective ☐	
Pre-requisite	Matrix Methods	To take effect from			
Course Objectives	Design for effectiveness – Level 1				
Course Outcomes	This course will help students understand • The importance of modeling systems to realize effective designs • Abstraction of key elements from problem situations • Use of specific techniques to model problems in a holistic manner				
Contents of the course	• Real-world problems & the need for inter-disciplinary approaches [2] • Basic concepts of systems thinking (parts, relations, patterns) [6] • Technique #1: Rich Pictures • Technique #2: Mapping Stakeholder, Needs, Alterables, Constraints [6] • Technique #3: Structural Modeling (Hierarchical decomposition) [6] • Technique #4: Influence Diagrams (Self-regulating systems) [6]				
Textbook	1. Hitchins, Derek K. (2007) Systems Engineering: A 21st Century Systems Methodology, John Wiley, ISBN: 978-0-470-05856-5. 2. Wilson, Brian (1991) Systems: Concepts, Methodologies and Applications. 2nd Edition, Wiley. ISBN: 0471927163. 3. Hutchinson, William; Systems Thinking and Associated Methodologies, Praxis Education. ISBN: 0 646 34145 6.				
References	1. Gerald Wienberg (2001), An introduction to general systems thinking, Dorset House Publishing. 2. Sage, A.P. (1977); Methodology for Large Scale Systems, McGraw Hill, New York.				

Course Title	Engineering Economics	Course No	To be filled by the office		
Specialization	Management	Structure (LTPC)	2	0	2
Offered for		Status	Core ■	Elective ☐	
Pre-requisite	Basic Mathematics	To take effect from			
Course Objectives	Help students learn basics of economics and cost analysis to make economically sound design decisions				
Course Outcomes	This course will help students understand: • the basics of micro-economics and cost analysis • Techniques to make economically sound decisions				
Contents of the course *(With approximate break up of hours)*	• Engineering Economic Decisions • Time is Money • Understanding Financial Statements • Cost Concepts and Behaviors • Understanding Money and Its Management • Principles of Investing • Present Worth Analysis • Annual Equivalent Worth Analysis • Rate of Return Analysis • Depreciation • Capital Budgeting Decisions				
Textbook	1. John A. White, Kellie S. Grasman, Kenneth E. Case, Kim LaScola Needy, David B. Pratt, "Fundamentals of Engineering Economic Analysis (First Edition)," Wiley 2014. 2. Chan S.Park, "Contemporary Engineering Economics," Prentice Hall of India, 2002.				
References	1. Blank Tarquin (2005). Engineering Economy. 6th Edition. McGraw-Hill.				

<table>
<tr><td>Course Title</td><td>Thermal Engineering – Concepts And Applications</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Mechanical Engineering</td><td>Structure (IPC)</td><td>3</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>B.Tech. MDM, DD (MPD, MFD)</td><td>Status</td><td colspan="3">Core ■ Elective □</td></tr>
<tr><td>Objectives</td><td colspan="5">In this course, undergraduate engineering students will learn the basic principles and concepts of classical thermodynamics. The students will understand the concept and develop ability to apply the basic principles in a systematic way to analyze basic thermodynamic cycles.</td></tr>
<tr><td>Contents of the course</td><td colspan="5">Fundamentals: System & Control volume, Property, State, Process, Cycle, Displacement work, Other forms of work, Zeroth law, Various thermometers, Definition of heat & work interaction. Tutorials. (8 hours)

First law: Cyclic & non-cyclic process, enthalpy and internal energy. Properties of pure substance, Ideal gas and their mixtures Water and steam: Constant temperature and constant pressure heating. Use of steam tables: Saturation tables, Superheated tables. Application of First law to flow processes, SFEE, Examples of steady flow devices such as nozzle, diffuser, turbine, compressor. Tutorials. (12 hours)

Second law: Qualitative difference between heat and work, Kelvin-Planck and Clausius statements. Heat engines and reversible heat engines, Carnot cycle, Definitions of thermal efficiency and COP, Definition of reversible process. Clausius inequality, Definition of entropy, Demonstration that entropy is a property. T-s diagram, Definition of isentropic efficiency, Available and unavailable energy, Concept of irreversibility and lost work. T-ds equations. Tutorials. (14 hours)
Thermodynamic Basic Cycles – Rankine cycle, Vapor compression cycle, Brayton cycle, Otto cycle, Diesel cycle – Comparison with Carnot cycle. Tutorials. (8 hours)</td></tr>
<tr><td>Textbook</td><td colspan="5">1. P. K. Nag, “Engineering Thermodynamics,” McGraw Hill Education (India) Private Limited, Fifth edition, 2013..</td></tr>
<tr><td>References</td><td colspan="5">1. Y. A. Cengel, “Introduction to Thermodynamics and Heat Transfer,” 2nd Edition, Tata McGraw - Hill Education, 2007.
2. C. Borgnakke and R. E. Sonntag, “Fundamentals of Thermodynamics,” 7th Edition, Wiley, 2009.</td></tr>
</table>

Course Title	Mechanics of Materials	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective □	
Course Objectives	The objective of this course is to introduce the principles of continuum mechanics as applied to the simplified case of elastic solids.				
Course Outcomes	At the end of the course, a student will be able to: 1. describe the material behavior under different kind of static loading conditions 2. analyze the problems related to deformation of elastic bodies 3. design simple structures under static loadings, i.e. beams, shafts, columns, etc.				
Contents of the course *(With approximate break up of hours)*	Review of equilibrium, compatibility, stress and strain at a point and Mohr's circle. (4) Pure bending of beams – shear force and bending moment diagrams; beams with composite cross-sections; Deflection of beams. (11) Torsion of circular cross sections – application and transmission of torque; Combined loads – application to pressure vessels and springs. (10) Theory of failures for ductile and brittle materials. (6) Buckling of columns – eccentric loading; various end constraints. (6) Virtual work – Energy methods – principle and applications (5).				
Textbook	1. F. P. Beer, E. R. Johnston, J. T. Dewolf, and D. Mazurek, "Mechanics of Materials," McGraw Hill, 7th Edition, 2014.				
References	1. R. C. Hibbeler, "Mechanics of Materials," Prentice Hall, 8th Edition, 2010. 2. A. C. Ugural, "Mechanics of Materials," Wiely, 1st Edition, 2007. 3. J. M. Gere and S. Timoshenko, "Mechanics of Materials," PWS Publishing Company, 4th Edition, 1997. 4. W. Nash and N. Malik, "Strength of Materials", McGraw Hill Education Pvt. Ltd, 4th Edition, 2010.				

Course Title	Basic Concepts in Manufacturing Processes	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective ☐	
Course Objectives	Students will learn fundamentals of conventional and non-traditional manufacturing processes and to interpret product requirements to select and/or synthesize suitable manufacturing processes.				
Course Outcomes	At the end of the course, a student will be able to: 1. Determine the appropriate manufacturing process(es) for the product to be made 2. Analyse the suitability of a manufacturing process to convert the raw material to designed specifications 3. Perform cost analysis for various manufacturing process to minimize the cost of processing the material				
Contents of the course *(With approximate break up of hours)*	Introduce manufacturing processes and provide basis for manufacturing process categories and classification, Basic concepts and applications of casting, Glass working, shaping processes for plastics, processing polymer matrix composites and rubber, powder metallurgy. (7) Metal forming; bulk deformation processes and sheet metal working, Theory of metal machining, machining operations and machine tools, cutting tool technology. (12) Fundamental of welding process, brazing, soldering and adhesive bonding. (5) Additive manufacturing processes, semi-conductor fabrication, micro and nano fabrication and advanced manufacturing processes. (12) Manufacturing Engineering, Economic modelling and cost analysis, Process selection. (6)				
Textbook	1. S. Kalpakjian, and S.R. Schmidt, "Manufacturing Engineering and Technology," 7th Edition, Pearson India, 2009. 2. M. P. Groover, "Principles of Modern Manufacturing," 5th Edition, Wiley, India, 2014.				
References	1. E. P. DeGarmo, J. T. Black, and R. A. Kohser, "DeGarmo's materials and processes in manufacturing," John Wiley & Sons, 2011. 2. I. Gibson, D. W. Rosen, and B. Stucker, "Additive manufacturing technologies," New York: Springer. 2010. 3. Stephenson, David A., and John S. Agapiou, "Metal cutting theory and practice," Vol. 68. CRC press, 2005. 4. S. Kalpakjian, and S. R. Schmid, "Manufacturing processes for engineering materials," 5th Ed. Pearson education, India, 2010.				

Course Title	Electrical Drives	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	1	3	3
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective □	
Course Objectives	In this course fundamental applications of electromechanical and power electronic systems will be studied as applied to mechanical systems. The capabilities and limitations of different types of electric machines (e.g., permanent magnet, induction) in various drive applications will be covered.				
Course Outcomes	At the end of the course, a student will be able to, 1. Understand how power electronic rectifiers, converters and inverters operate. 2. Possess an understanding of control of electrical drives. 3. Analyze and compare the performance of DC and AC machines. 4. Design control algorithms for electric drives which achieve the regulation of torque, speed, or position in the above machines. 5. Develop Simulink® models which dynamically simulate electric machine and drive systems and their controllers.				
Contents of the course *(With approximate break up of hours)*	Experiments conducted in this course brings out the basic concepts of different types of electrical machines and their performance. Experiments are conducted to introduce the concept of control of conventional electric motors such as DC motor, AC Induction motor and also special machines such as Stepper motor, Permanent magnet brushless motors, Servo motor. Speed-Torque characteristics of various types of load and drive motors are also discussed. The working principle of various power electronic converters is also studied by conducting experiments.				
Textbook	1. IIITDM Kancheepuram Electrical Drives Practice Manual				
References	1. R. Krishnan, "Electric Motor Drives: Modeling, Analysis, and Control," Prentice Hall, 2001. 2. N. Mohan, "Electric Drives: An Integrative Approach," MNPERE, 2001.				

Course Title	Machine Drawing and Manufacturability Analysis Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective □	
Course Objectives	To familiarize 3D modeling and to gain an understanding of industrial drafting practices				
Course Outcomes	At the end of the course, a student will be able to: 1. Develop 3D models of machine components and generate 2D drawing from 3D models 2. Digitize existing products using reverse engineering 3. Create assembled and exploded views of machine components 4. Analyze the machine component design for its manufacturability, environmental impact and ease of assembly using 3D models				
Contents of the course	Students will be modeling machine components and its assembly in 3D modeling software using feature based design concepts. In addition students will also digitize existing products using simple measurement and digitizing tools. Students will also create assembled views and exploded views of machine assemblies. Students will generate associated 2D drawings from 3D models and create production drawings using standard notations of GD&T. In addition students will also perform tolerance stack-up analysis using worst case tolerance analysis method. Students will analyze the machine component design for its manufacturability, environmental impact and ease of assembly.				
References	1. Bertoline, Wiebe, Miller, Nasma., "Technical Graphics Communication," IR WIN Graphic Series, 2008. 2. S. Bogolyubov. A. Voinov., "Engineering Drawing," Van Nostrand Reinhold Company, 2001. 3. D. E. Hewitt., "Engineering Drawing and Design for Mechanical Technicians," The Macmillan Press Ltd, London, 2006. 4. Boothroyd G., Dewhurst P., and Knight W. A., "Product Design for Manufacture and Assembly," 3rd Edition, CRC Press, 2010. 5. Michael F. Ashb, "Materials and the Environment: ECO-Informed Material Choice, Elsevier, 2012.				

Course Title	Product Realization Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective □	
Course Objectives	Students will gain a practical knowledge of various manufacturing processes in a hands-on environment through experiments and simulations.				
Course Outcomes	At the end of the course, a student will be able to: 1. Realize products using primary manufacturing processes 2. Develop a practical understanding of basic manufacturing processes and capabilities of each. 3. Identify and rectify defects in parts and manufacturing processes related problems. 4. Analyze data from experiments performed and reach conclusions.				
Contents of the course *(With approximate break up of hours)*	Students will realize simple cylindrical shapes using manual and CNC lathe. Facing, turning, multiple turning and thread cutting operations will be performed to machine the cylindrical part. Similarly experiments will be conducted on CNC milling machine to realize prismatic parts with simple features like pockets, slots, step and holes. Experiments will be performed to measure cutting forces in universal milling machines using dynamometer. Arc welding process will be simulated for distortion and quality of weld joint will be inspected using ultrasonic testing. In addition, experiments on sheet metal bending will be carried out to measure springback. Students will be performing experiments with entire process chain in 3D printing using fusion deposition modeling process and finally a composite material will be fabricated using hand lay-up technique.				
References	1. E. P. DeGarmo, J. T. Black, and R. A. Kohser, "DeGarmo's materials and processes in manufacturing," John Wiley & Sons, 2011. 2. M. P. Groover, "Principles of Modern Manufacturing," 5th Edition, Wiley, India, 2014 3. S. Kalpakjian, and S. R. Schmid, "Manufacturing processes for engineering materials," 5th Ed. Pearson Education, India. 2010.				

Course Title	Numerical Methods	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective ☐	
Course Objectives	The objective of this course is to introduce numerical methods for mechanical engineering students. This course is aimed at providing techniques to solve a system of linear and non-linear equations and also ODEs and PDEs.				
Course Outcomes	At the end of the course, a student will be able to solve system of linear equations, obtain eigen values, solve ODEs and PDEs, and obtain optimum numeric solutions to engineering problems.				
Contents of the course *(With approximate break up of hours)*	**General Numerical methods:** Introduction, solution of equations by iteration, interpolation, numeric integration and differentiation. (6) **Numeric linear algebra:** Linear systems - LU factorization, solution by iterations. Matrix eigen value problems - QR factorization. (8) **Numerics for ODEs and PDEs:** First order ODEs, multistep methods, higher order ODEs, PDEs. (10) **Optimization:** Non-linear programming; Linear programming – simplex method. (10) Case studies related to mechanical engineering problems. (8)				
Textbook	1. E. Kreyszig, "Advanced Engineering Mathematics," Wiley, 9th Edition, 2014.				
References	1. B. S. Grewal and J. S. Grewal, " Numerical methods in Engineering and Science," 6th Edition, Khanna Publishers, New Delhi, 2004. 2. D. G. Luenberger, "Linear and Nonlinear Programming," Springer, 3rd Edition, 2008. 3. K. E. Atkinson, "An Introduction to Numerical Analysis," Wiley, 2nd Edition, 1989.				

Course Title	Designing Intelligent Systems	Course No	To be filled by the office		
Specialization	Design	Structure (LTPC)	2	0	2
Offered for	UG and DD	Status	Core ■	Elective ☐	
Pre-requisite	Systems Thinking for Design	To take effect from			
Course Objectives	Design for effectiveness – Level-2				
Course Outcomes	This course will help students understand • Principles of complex and living systems • Concepts such as Information intensity & Knowledge • Introduction to emerging digital technologies • Apply these ideas in design				

Contents of the course *(With approximate break up of hours)*	• Design Metaphors & Patterns (incl biomimetic) **[10]**
	  • Metaphors such as living systems, complex networks, viable systems
	  • Key principles governing living / complex systems (Self-organization, self-production, recursion, fractal)
	• Increasing information-intensity in products **[8]**
	  • Concept of information intensity vs material/energy intensity
	  • Self-learning, usage patterns, early warning systems
	  • Using data, voice, collaborative technologies (semantic, big data, speech, Remote-help, Indic computing), Internet-of-things
	• Synthesizing the above ideas for creative design **[8]**				

Textbook and References	1. H. G. Hey, A. M. Agogino, "Metaphors in Conceptual Design," ASME Design Engineering Technical Conferences, Las Vegas, Nevada, in review, 2007. 2. H. Casakin, and G. Goldschmidt, "Expertise and the Use of Visual Analogy: Implications for Design Education," Design Studies, 20(2), 153-175, 1999. 3. Kryssanov, V. V., Tamaki, H. and Kitamura, S., "Understanding Design Fundamentals: How Synthesis and Analysis Drive Creativity, Resulting in Emergence," Artificial Intelligence in Engineering, 15, 329 – 342, 2001.				

Course Title	Sociology of Design	Course No	To be filled by the office		
Specialization	Management	Structure (LTPC)	2	0	2
Offered for	UG and DD	Status	Core ■	Elective ☐	
Pre-requisite	None	To take effect from			
Course Objectives	Design as a Social Activity – Level 1				
Course Outcomes	This course will help students understand • Design as a social activity involving people, their relationships & values - How designs can emerge out of or be constrained by social patterns of relating • How technology can influence interactions among people, cooperative work, ethical issues around technology interventions • Exposure to techniques like ethnomethodology				
Contents of the course *(With approximate break up of hours)*	Basics concepts of sociology (behavior, interaction, language) **[6]** Historical evolution of Societies (Agrarian, Industrial, Digital) and current human and organizational contexts in which engineers and other professionals work, Personal and corporate social responsibility & ethics **[10]** Relationship between people (age, gender, cultures) and technology - Social and psychological dimensions of technological change, Technology & Work, Co-operative Work & Coordinative Practices, Ethnomethodology, Critical Systems Heuristics **[10]**				
Textbook and References	1. Manuel Castells (1996); The Rise of Network Society. 2. Herbert Blumer (1986); Symbolic Interactionism: Perspective and Method. 3. Herkert, J. (ed.), Social, Ethical, and Policy Implications of Engineering: Selected Readings. New York, NY: IEEE Press, 2000. 4. Heath, C. and Luff, P. (2000); Technology in Action, Cambridge: Cambridge Univ Press. 5. Werner Ulrich (1983), Critical Systems Heuristics, John Wiley, London.				

Course Title	Fluid Mechanics And Heat Transfer	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective □	
Objectives	In this course, undergraduate engineering students will learn the basic principles and concepts of fluid statics and mechanics. The students will be given a feel for how fluid mechanics is applied in engineering practices such as drag & lift, pipe flow and fluid machinery. Students will be taught basic concepts and mechanisms of heat transfer. Emphasis will be given for mathematical formulation of practical heat conduction problems and also the physical significance of various concepts and fundamental definitions associated with the study of convection.				
Contents of the course	Fluid Mechanics – Classification of fluid motion – Basic equations of hydrostatics – Analysis of submerged surfaces – Buoyancy and stability – Reynolds transport theorem - Conservation of mass, momentum and energy – Viscous and turbulent flows – Applications to pipe and bluff body flows. Tutorials. (12 hours) Introduction and classification of fluid machines – Analysis of turbo machinery flows – Positive displacement, rotodynamic and centrifugal turbine and pumps – Pelton wheel, Francis turbine and Kaplanturbine, reciprocating and centrifugal pump – Specific speed – NPSH. Tutorials. (10 hours) Conductive heat transfer – General conduction equation – One dimensional steady state conduction –Transient conduction - Fins and extended surfaces. Tutorials. (8 hours) Convective heat transfer – Boundary Layers – Dimensionless group for convection – Forced convection – Elements of free convection. Tutorials. (8 hours) Elements of Radiation heat transfer. Tutorials. (4 hours)				
Textbook	1. S K Som, Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics & Fluid Machines, McGraw Hill Education (India) Private Limited; 3rd edition; 2011. 2. J P Holman and Souvik Bhattacharyya, Heat Transfer, McGraw Hill Education (India) Private Limited; 10th edition; 2011				
References	1. Robert W. Fox, Philip Journal Pritchard and Alan T. McDonald, Introduction to Fluid Mechanics, 8th Edition, (ISBN: 9788126541287) Wiley India Pvt. Ltd.-New Delhi, 2013. 2. Merle C Potter, David C Wiggert and Bassem H Ramadan, Mechanics of Fluids, Cengage Learning India; 04th edition; 2012. 3. Incropera, Dewitt, Bergmann, Lavine, Fundamentals of Heat and Mass Transfer, Wiley; Sixth edition, 2010. 4. Frank Kreith, Mark S. Bohn, Raj Manglik, Principles of Heat Transfer, Cengage Learning Custom Publishing; 7th International student edition, 2010.				

Course Title	Kinematics and Dynamics of Mechanisms	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective □	
Course Objectives	The objective of this course is to provide the fundamentals to understand the kinematics and kinetics of various mechanisms and machineries.				
Course Outcomes	At the end of the course, a student will be able to: 1. demonstrate a good understanding of the principles of rigid body motion 2. predict the effects of force, motion and their interaction in the design of simple mechanisms and machines 3. investigate problems related to balancing and vibrations of machines.				
Contents of the course *(With approximate break up of hours)*	Introduction to mechanisms- joints, pairs and couplings; Constraints, mobility and degree of freedom, Kutzbach and Grubler criterion, Grashof's law. (7) Kinematics (Position, Velocity and Acceleration) of rigid bodies – analytical and graphical methods. (12) Kinematic synthesis of mechanisms, gears, gear trains and cams. (12) Dynamics of planar mechanisms – slider crank forces, engine balancing. (6) Review of vibrations; Harmonically excited vibration; Vibration isolation. (5)				
Textbook	1. J.J. Uicker, G.R. Pennock and J.E. Shigley, Theory of Machines and Mechanisms, Oxford University Press, 4th Edition, 2010.				
References	1. S. S. Rattan, "Theory of Machines," Tata McGraw-Hill, 2005. 2. J. S. Rao, and R. V. Dukkipati, "Mechanism and Machine Theory," New Age International, 2006. 3. A. Ghosh and A. K. Mallik, "Theory of Mechanism and Machines," Affiliated East – West Press Private Ltd., 2009. 4. T. Bevan, "Theory of Machines," Pearson Education, 3rd Edition, 2009.				

Course Title	Quality Inspection and Product Validation	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective ☐	
Course Objectives	To impart knowledge on inspection, measurement, quality control, validation and certification of products				
Course Outcomes	At the end of the course, a student will be able to: 1. Understand various metrology principles and techniques 2. Identify and select suitable techniques and equipments to inspect and to ensure product quality 3. Know about various quality control methodologies, standards and certifications				
Contents of the course *(With approximate break up of hours)*	**Basic concepts:** Measurement and inspection; Role of metrology in quality assurance; Errors; Length standards; Gauges and comparators; Linear and angular measurements; Fits and tolerances. (10) **Measurement Practices:** Optical metrology and laser interferometers; Measurement of flatness, straightness and form errors; Surface finish measurements; CMM; Vision applications in Metrology; Nano-measurements. (10) **Statistical Methodologies:** Graphical methods, Statistical control charts, Regression analysis, Analysis of variance, Sampling and acceptance. (8) **Standards and Certifications:** BIS, ISO, SAE, ASME, ASTM, IEEE. (6) **Case studies:** Inspection and Validation practices adopted in various industries. (10)				
Textbook	1. T. G. Beckwith, R. D. Marangoni, and J. H. Lienhard, "Mechanical Measurements," 6th Edition, Pearson Higher Education, ISBN: 0132296071, 2007. 2. R. K. Jain, "Engineering Metrology," Khanna Publishers, ISBN: 817409153X, 20th Reprint, 2014.				
References	1. D. J. Whitehouse, "Hand book of surface and nanometrology," 2nd Edition, CRC Press, ISBN: 9781420082012, 2010. 2. G. T. Smith, "Industrial Metrology," Springer, ISBN: 9781852335076, 2002. 3. A. M. Badadhe, "Metrology and Quality Control," Technical Publications, ISBN: 8189411861, 2006. 4. R. C. Gupta, "Statistical Qualtiy Control," Khanna Publishers, ISBN: 8174091114, 8th Edition, 2008.				

Course Title	Mechanical Design Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective ☐	
Course Objectives	Students will gain practical knowledge on the strength of materials under different loadings, and the kinematics and kinetics of various mechanisms and machineries.				
Course Outcomes	At the end of the course, a student will be able to 1. explain the behavior of materials under different kinds of loading conditions 2. investigate influence of geometry on load bearing capacity, and the stability of materials 3. analyze the effects of force, motion and their interactions in simple mechanisms and machineries.				
Contents of the Course	Experiments are designed to realize the influence of geometry and the strength of materials on structural elements like beam bending and column buckling. Kinematic simulations for various mechanisms and inversions are included. Experiments based on the concepts of kinematics and dynamics of machine elements like cams, balancing of masses, vibrations and gyroscope are also incorporated.				
References	1. F. P. Beer, E. R. Johnston, J. T. Dewolf, and D. Mazurek, "Mechanics of Materials," McGraw Hill, 7th Edition, 2014. 2. R. C. Hibbeler, "Mechanics of Materials," Prentice Hall, 8th Edition, 2010. 3. A. C. Ugural, "Mechanics of Materials," Wiley, 1st Edition, 2007. 4. J. M. Gere and S. Timoshenko, "Mechanics of Materials," PWS Publishing Company, 4th Edition, 1997.				

Course Title	Quality Inspection and Product Validation Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective ☐	
Course Objectives	Students will learn to calibrate and understand the sources of various measurement errors and familiarize with the use of metrological equipments				
Course Outcomes	At the end of the course, a student will be able to: 1. Identify suitable metrology instruments, gauges, and tools 2. Calibrate and understand the sources of various measurement errors 3. Familiarize with the use of metrological equipments such as CMM, Video Microscopes and Vision systems 4. Apply various statistical control charts in process control				
Contents of the course *(With approximate break up of hours)*	Experiments will be performed to calibrate instruments used for measuring dimensional and geometric tolerances and understand various sources of error. Measurement activities involving, linear, angular measurements on various parts will be carried out. Training on practical applications of quality control charts will be given through case studies. Experiments will be performed on surface profiler to measure surface finish related parameters. Profile measurements using profile projector will be carried out and practical experiment on tool maker's microscope will be carried out for inspecting threads. Measurement of dimensional and geometric tolerances using contact (CMM) and non contact (autocollimator, video microscopy, profile projector and other optical) methods will be performed.				
References	1. T. G. Beckwith, R. D. Marangoni, and J. H. Lienhard, "Mechanical Measurements," 6th Edition, Pearson Higher Education. 2. R. K. Jain, "Engineering Metrology," Khanna Publishers, 20th Reprint, 2014. 3. R. C. Gupta, "Statistical Qualtiy Control," Khanna Publishers, 8th Edition, 2008.				

Course Title	Fluid Mechanics and Heat Transfer Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. MDM, DD (MPD, MFD)	Status	Core ■	Elective □	
Content	To provide an experimental basis for the theoretical concepts such as viscocity, pressure, flow, hydrostatic forces, conduction, convection, radiation, etc. To familiarize students with fluid mechanics and heat transfer equipments and setups such as loss coefficient in pipe fittings, turbines and pumps, fins, heat exchangers, etc. To provide an opportunity to students to build and test simple experiments related to fluid mechanics and heat transfer.				
References	Fluid Mechanics and Heat Transfer Laboratory Manual, IIITDM Kacheepuram.				

Syllabus of B. Tech. Mechanical Engineering (Design and Manufacturing) + M. Tech. Advanced Manufacturing (MFD) from 5th to 10th Semesters
(According to 31st Senate meeting held on 1st July 2016)

Course Title	Sustainable Design	Course No	To be filled by the office		
Specialization	Design	Structure (IPC)	2	0	2
Offered for	UG and DD	Status (Core / Elective)	Core		
Prerequisite	Earth Environment and Design	To take effect from			
Course Objectives	The objective of this course is to prepare engineering students to address product design from a broader, holistic perspective, integrating environmental responsibility into the core of the design process.				
Course Outcomes	Upon completion of the course students are expected to demonstrate knowledge, skill and abilities in the following areas: • To equip the design student with specific environmentally-responsive tools, principles and methodologies in preparation for professional application. Management • To use a variety of techniques to communicate effectively (sketches, illustrations, photographs, persuasive writing, presentation skills, etc.).				
Contents of the course	Introduction, Definitions, History • the environmental origins of sustainability • theory of sustainability. (4) Environmentally-responsive design methodologies • industrial ecology • dematerialization • design for reuse / modularity • design for recycling • remanufacturing: issues/problems, current and future developments (10) Alternative resources • alternative energy • alternative materials • sustainable packaging. (10) Life-cycle assessment methods. (8)				
Textbooks	1. Victor Papanek, The Green Imperative, 1995, ISBN: 978-0500278468 2. William McDonough and Michael Braungart, Cradle to Cradle, 2009, ISBN: 978-0099535478 3. Stuart Walker, Sustainable by Design: Explorations in Theory and Practice, 2006, ISBN: 978-1844073535 4. Charter, Tischner, Sustainable Solutions, Green Leaf Publishing, 2001, ISBN: 978-1874719366.				
References	1. Cattanach, Holdreith, Reinke, Sibik, The Handbook of Environmentally Conscious Manufacturing, 1995, ISBN: 9780786301478 2. Sim van der Ryn, Stuart Cowan, Ecological Design, 1995, ISBN: 978-1559633895 3. Paul Hawken, The Ecology of Commerce, 2010, Collins Business Essentials, ISBN: 978-0061252792 4. Nattrass & Altomare, The Natural Step for Business, New Society Publishers, 1999, ISBN: 978-0865713840.				

Course Title	Entrepreneurship and Management Functions	Course No	To be filled by the office		
Specialization	HMC	Structure (IPC)	2	0	2
Offered for	UG and DD	Status (Core / Elective)	Core		
Prerequisite	Systems Thinking and Design	To take effect from			
Course Objectives	The objective of this course is to provide engineering students an exposure to the basic concepts of entrepreneurship and management, with a specific focus on the process of turning an idea into a commercially viable venture.				
Course Outcomes	At the end of the course, the students will learn how to • Understand the market & competition • Prepare a business case for the product/idea				
Contents of the course	Introduction • Division of labor and creation of value • Evolution of organizations, industries and sectors, for profit and non-profit • Role of Entrepreneurs and Managers in value creation • Principles of Management - Planning, Organizing, Resourcing, Directing (4) Strategy & Planning • Understanding industry dynamics & competition (Porter's Framework) • Understanding the industry value chain and firm positioning (6) Organizing • Typical organizational functions (R&D, Marketing & Sales, HR, Operations) • Cybernetics of organizational functions (Stafford Beer's viable systems model) • Types of organization structures (product, functional, matrix, global) (6) Resource Management • Financial management (Sources of funding, how to read a P&L, balance sheet) • Human resource management (Interviewing, compensation, motivation) • Global sourcing and supply chain management (8) Management Information & Decision Making (4) Legal and Regulatory environment (4)				
Textbooks	1. Peter F Drucker, The Practice of Management, Harper Collins, 2006, ISBN: 978-0060878979. 2. Hentry Mintzberg, Managing, Berret-Koehler Publishers, 2009, ISBN: 978-1605098746 3. Michael E. Porter, On competition, A Harvard Business School, 2008, ISBN: 978-1422126967. 4. Vasanta Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, ISBN: 9788183184113.				
References	1. Walter Isaacson, Steve Jobs, 2011, ISBN:978-1451648539 2. Eric Ries, The Lean Startup, Portfolio Penguin, 2011, ISBN: 978-0307887894 3. Vineet Bajpai, Build from scratch, Jaico books, 2013, ISBN: 9788184952919.				

Course Title	Thermal Energy Systems	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD	Status (Core / Elective)	Core		
Prerequisite	Thermal Engineering - Concepts and Applications, Fluid Mechanics and Heat Transfer	To take effect from			
Course Objective	In this course, undergraduate engineering students will learn to apply the basic concepts of thermal sciences to real processes. The course focuses on an in-depth study of major energy conversion systems, such as internal combustion engines, power plants, refrigeration and air conditioning systems.				
Course Outcome	To acquire the knowledge of energy conversion technologies				
Contents of the course	Heat exchangers – direct and indirect contact, boilers, condensers, evaporators, compactness, flow arrangement, effectiveness LMTD and $\in -$ NTU method. (8) Internal combustion engines: Fuels, Stoichiometric air-fuel ratio, air-standard and real cycles, difference between two and four-stroke engines, Intake and exhaust systems, Detonation and knocking, Exhaust emissions & control. (12) Steam Cycles: Rankine cycle, Rankine Cycle with reheat & superheat, Regenerative cycle, Plant efficiency, Cogeneration. (10) Refrigeration and Air-Conditioning Systems: Vapour-compression cycle, Effect of sub-cooling and superheating, COP of cycle, Effect of various parameters on COP, Multistage systems, Cascade systems, Vapour-absorption cycle, Gas cycles, Refrigerants, Air-conditioning systems, cooling towers, Cooling and dehumidification. (12)				
Textbooks	1. J. P. Holman and S. Bhattacharyya, Heat Transfer, 10th edition, McGraw-Hill Education (India) Private Limited, 2011. 2. T. D. Eastop, A. McConkey, Applied Thermodynamics for Engineering Technologists, 5th edition, Pearson India, 2002. ISBN: 9788177582383				
References	1. P. K. Nag, Power Plant Engineering, 4th edition, McGraw Hill Education (India) Private Limited, 2014. ISBN: 9789339204044 2. Wilbert F. Stoecker and J. W. Jones, Refrigeration and Air Conditioning, 2nd edition, McGraw-Hill Higher Education, 2002. ISBN: 9780070665910 3. John Heywood, Internal Combustion Engine Fundamentals, McGraw Hill-Education (India) Private Limited, 2011. ISBN: 9781259002076				

Course Title	Design of Machine Elements	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD	Status (Core / Elective)	Core		
Prerequisite	Engineering Mechanics, Mechanics of Materials	To take effect from			
Course Objectives	The objective of this course is to introduce design concepts and procedures necessary to design and/or select a machine component in terms of geometry and materials				
Course Outcomes	At the end of the course, a student will be able to • analyze the stresses in machine elements and structural members under various loads • apply multidimensional failure criteria in the analysis and design of machine components • design power transmission systems involving belts, clutches, gears • determine the fatigue life of shafts, gears and bearings under varying loads				
Contents of the course	Design for variable loading - fatigue strength and design; design of shafts. (10) Design of bolts and Power Screws. (6) Theory of friction drives. Design and selection of belt drives; Design of clutches. (8) Design of Gears: spur and worm gears, Contact and bending fatigue strength, Gear accuracy. (10) Tribology: Lubricant theories, Design of Journal bearings, Selection of ball and roller bearings. (8)				
Textbooks	1. V. Bhandari, Design of Machine Elements, 3rd edition McGraw-Hill Education, 2010.				
References	1. R. G. Budynas, K. J. Nisbett, Mechanical Engineering Design, 10th edition, McGraw-Hill Higher Education, 2014. 2. R. L. Norton, Machine Design, 5th edition, Prentice Hall, 2013. 3. C. S. Sharma and K. Purohit, Design of Machine Elements, Prentice Hall, 2008. 4. P. C. Gope, Machine Design: Fundamentals and Applications, Prentice Hall India, 2011.				

Course Title	Automation in Manufacturing	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD	Status (Core / Elective)	Core		
Prerequisite	---	To take effect from			
Course Objectives	The objective of this course is to learn the techniques and methodologies of integrating various mechatronic and automation devices in manufacturing systems. Particularly, students will study in detail on the contribution of hydraulic, pneumatic and robotic systems and PLCs in manufacturing systems.				
Course Outcomes	At the end of the course, a student will be able to • Integrate various electro-mechanical devices in manufacturing. • Develop pneumatic and hydraulic circuits for manufacturing applications. • Automate a manufacturing system with various sensors, actuators and controllers.				
Contents of the course	Mechatronic Systems: Overview of mechatronic systems and devices in manufacturing, automated feeding, transfer, retrieval mechanisms and devices, AGVs, FMS workstations, material handling and storage systems, overview of sensors, transducers and control systems in manufacturing. (6) Hydraulic Systems: Hydraulic systems: flow, pressure and direction control valves, actuators, supporting and control elements, pumps, servo valves and actuators, electro hydraulic servo-valves, proportional valves and their applications, design of hydraulic circuits for mfg applications and performance analysis. (10) Pneumatic Systems: Production, distribution and conditioning of compressed air, system components and graphic representations, design of circuits-switching circuits and sequential circuits, cascade methods, step counter method, compound circuit design. (10) Robotics in Automation: Robot classification and anatomy, forward and inverse kinematics, DH matrix transformation, Jacobian and differential motion, Trajectory planning, Static and dynamic analysis, applications in manufacturing. (12) PLCs and Microprocessors: Basic structure - Input / Output processing - Programming - Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC, Programming and interfacing of microprocessors in manufacturing applications. (6)				
Textbooks	1. A. Esposito, Fluid power with applications, 7th edition, 2008, Prentice Hall. 2. M. P. Groover, Industrial Robotics: Technology, Programming and Applications, 2nd edition, McGraw-Hill, 2012, ISBN: 9780070265097.				
References	1. K. S. Fu, Robotics: control, sensing, vision and intelligence, Mcgraw-Hill, 1987. 2. W. Bolton, Mechatronics: electronic control systems in mechanical and electrical engineering, McGraw Hill, 2009. 3. HMT Limited. Mechatronics, Tata-McGraw-Hill, 2000, ISBN: 9780074636435. 4. S. R. Deb, Robotics technology and flexible automation, 2nd edition, Tata McGraw-Hill, 2009. 5. T. O. Boucher, Computer automation in manufacturing - an Introduction, Chapman and Hall, 1996. 6. Morris A. Cohen and Uday M. Apte, Manufacturing Automation, McGraw Hill, New York, 1997, ISBN 0-256- 14606-3. 7. J. J. Craig, Introduction to Robotics: Mechanics and Control, 3rd edition, Prentice Hall, 2004, ISBN: 978-0201543612. 8. A. Ghoshal, Robotics Fundamental Concepts & Analysis, Oxford University Press; 2006, ISBN: 9780195673913				

Course Title	Sensors and Controls	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	The objective of this course is to learn the basic working principle and operation of various sensors and sensor based control of electro-mechanical equipments and devices.				
Course Outcomes	At the end of the course, a student will be able to • understand the working principle of various sensors. • calibrate a sensor for acquiring data. • develop a control scheme based on sensor feedback.				
Contents of the course	Introduction: Description of measuring devices and dynamic characteristics, active and passive sensors and transducers, classifications. (4) Motion Sensors: Resistive strain gauge, LVDT, RVDT, capacitive, piezo, seismic pickups, vibrometers and accelerometers. (6) Sensors and Transducers for: flow, temperature, force, pressure and torque sensors; Current, torque and speed measurements using digital measurement techniques. (6) Optical sensors: Lasers. photo-detectors and optical fiber as sensors (4) Sensors in Robotics: Classification, Characteristics, Internal Sensors – position, velocity, acceleration sensors, Force sensors, External sensors – proximity, touch and slip sensors. Robotic vision, Process of Imaging, Architecture of Robotic Vision Systems, Image Acquisition, Components of Vision System, Image Representation, Image Processing. (8) Advanced Sensors: Semiconductor sensors, Hall elements. Silicon sensors for sensing radiation, mechanical, magnetic, chemical and other signals, Catalytic devices, gas sensors and acoustic sensors. (8) Sensor based Control: Types of controllers, electrical, pneumatic and hydraulic prime movers and associated control hardware, closed loop control of microcomputer based drives. Relay control systems and PLC systems and programming, control including sequence control. Sensor based control of various actuators, mechatronic devices and autonomous mobile robots. (8)				
Textbooks	1. J.Vetelino, A. Reghu, Introduction to Sensors, CRC Press, 2010. ISBN 9781439808528. 2. J. Fraden, Handbook of Modern Sensors: Physics, Designs and Applications, 4th edition, Springer, 2010.				
References	1. T. G. Beckwith, R. D Marangoni, J. H. Lienhard, Mechanical Measurements, Pearson Prentice Hall, 2009. 2. Doebelin, Measurement systems: Applications and Design; 5th edition, McGraw Hill Book, 2004. 3. I. R. Sinclair, Sensors and Transducers, Elsevier, 2001, ISBN: 978-0-7506-4932-2. 4. J. S. Wilson, Sensor Technology Handbook, Newnes, 2004, ISBN: 0750677295. 5. B. K. Ghosh, T. J. Tarn, N. Xi, Control in Robotics and Automation: Sensor-Based Integration, Academic Press, 1999, ISBN: 0123886120; 978-0-12-281845-5 6. C. W. de Silava, Sensors and Actuators, 2nd edition, CRC Press, 2016.				

Course Title	Thermal Engineering Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	UG and DD	Status (Core / Elective)	Core		
Pre-requisite	-----	To take effect from			
Course Objective	In this practice course, undergraduate engineering students will conduct experiments to understand the various concepts taught in thermal engineering courses.				
Course Outcome	To acquire practical knowledge in various modern thermal systems				
Content	To familiarize students with thermal engineering related equipments and experimental setups such as Flash point & fire point, Calorific value, Reciprocating compressor, Refrigeration system, Air conditioning system, Mini power plant (Rankine Cycle), Solar water heater, Valve timing diagram, SI Engine, Cooling tower				
Textbooks	1. Thermal Engineering Laboratory Manual, IIITDM Kancheepuram				
References	1. V. Ganesan, Internal Combustion Engineering, 4th edition, McGraw Hill-Education (India) Private Limited, 2012 (ISBN-13: 978-1259006197).				

Course Title	Sensors and Controls Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	UG and DD	Status (Core / Elective)	Core		
Pre-requisite	----	To take effect from			
Course Objectives	To acquire hands on experience in selection, calibration and measurement of engineering parameters using various sensors.				
Course Outcomes	At the end of the course, a student will be able to: • Select a suitable sensor for a particular instrumentation task. • Calibrate a sensor and to integrate it with signal conditioning and data acquisition systems. • Design, analyze and implement virtual instrumentation.				
Contents of the course	The students will be able to identify the suitable sensor for a particular measure and identify the associated instrumentation devices. They will gain knowledge on calibration methods, various errors of instrumentation, error analysis, error plots and application of linearization principles. They will acquire hands on experience in virtual instrumentation, integration of filters and signal conditioners and data acquisition. They will familiarize to integrate various sensors, data loggers and actuators. Students will develop various sensor based control schemes for real time implementation. The students will be exposed to multi sensor data acquisition and data analysis.				
Textbooks	1. J. Vetelino, A. Reghu, Introduction to Sensors, 2010, CRC Press, ISBN 9781439808528. 2. J. Fraden, Handbook of Modern Sensors: Physics, Designs and Applications, 4th edition, Springer, 2010.				
References	1. T. G. Beckwith, R. D. Marangoni, J. H. Lienhard, Mechanical Measurements, Pearson Prentice Hall, 2009. 2. Doebelin, Measurement systems: Applications and Design; 5th edition, McGraw Hill Book, 2004. 3. I. R. Sinclair, Sensors and Transducers, Elsevier, 2001, ISBN: 978-0-7506-4932-2. 4. J. S. Wilson, Sensor Technology Handbook, Newnes, 2004, ISBN: 0750677295. 5. B. K. Ghosh, T. J. Tarn, N. Xi, Control in Robotics and Automation: Sensor-Based Integration, Academic Press, 1999, ISBN: 0123886120; 978-0-12-281845-5 6. C. W. de Silava, Sensors and Actuators, 2nd edition, CRC Press, 2016.				

Course Title	Manufacturing Automation Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	UG and DD	Status (Core / Elective)	Core		
Pre-requisite	-----	To take effect from			
Course Objectives	To acquire hands on experience in integrating various mechatronic and automation devices such as hydraulic, pneumatic, robotic systems, PLCs and computers in manufacturing systems.				
Course Outcomes	At the end of the course, a student will be able to • Integrate various electro-mechanical devices in manufacturing. • Develop pneumatic and hydraulic circuits for manufacturing applications. • Automate a manufacturing system with various sensors, actuators, robot mechanisms, PLCs and other controllers.				
Contents of the course	Integration of various sensors, actuators and other mechatronic devices in manufacturing applications. Identification of faulty components, orientation errors, assembly errors etc. Computer based design and simulation of automated manufacturing systems. Design, development and implementation of pneumatic and hydraulic circuits for the given manufacturing problem. Programming and integration of robot mechanisms in manufacturing automation. Programming and integration of PLCs and control of equipments in manufacturing. Design and development of microprocessor and computer based control schemes in Mfg. automation.				
Textbooks	1. A. Esposito, Fluid power with applications, 7th edition, 2008, Prentice Hall. 2. M. P. Groover, Industrial Robotics: Technology, Programming and Applications, 2nd edition, McGraw-Hill, 2012, ISBN: 9780070265097.				
References	1. K. S. Fu, Robotics: control, sensing, vision and intelligence, Mcgraw-Hill, 1987. 2. W. Bolton, Mechatronics: electronic control systems in mechanical and electrical engineering, McGraw Hill, 2009. 3. HMT Limited. Mechatronics, Tata-McGraw-Hill, 2000, ISBN: 9780074636435. 4. S. R. Deb, Robotics technology and flexible automation, 2nd edition, Tata McGraw-Hill, 2009. 5. T. O. Boucher, Computer automation in manufacturing - an Introduction, Chapman and Hall, 1996. 6. Morris A. Cohen and Uday M. Apte, Manufacturing Automation, McGraw Hill, New York, 1997, ISBN 0-256- 14606-3. 7. J. J. Craig, Introduction to Robotics: Mechanics and Control, 3rd edition, Prentice Hall, 2004, ISBN: 978-0201543612. 8. A. Ghoshal, Robotics Fundamental Concepts & Analysis, Oxford University Press; 2006, ISBN: 9780195673913.				

Course Title	Design for Quality and Reliability	Course No	To be filled by the office		
Specialization	Design	Structure (IPC)	2	0	2
Offered for	UG and DD	Status (Core / Elective)	Core		
Prerequisite	Measurements and Data Analysis Lab (Probability and Statistics)	To take effect from			
Course Objectives	The objectives of the course are to help engineering students understand: 1. To understand concepts of quality & reliability 2. To evaluate the overall reliability of a system from component reliability.				
Course Outcomes	Attending the course would enable the student to: 1. Model repairable and non-repairable systems and calculate failure rate, repair rate, reliability and availability 2. Use various probability density distributions significant to reliability calculations 3. Fit a given failure data set of a product into a Weibull distribution and estimate the reliability parameters.				
Contents of the course	Concepts of Product Quality • Quality Function Deployment / House of Quality • Six Sigma (6) Concepts of Reliability • Basic concepts of repairable and non-repairable systems • Reliability, Availability and Maintainability (6) Failure data analysis • Fitting discrete and continuous distributions to failure data sets, Weibull analysis, estimation of important reliability parameters (8) Calculation of System Reliability from Component reliabilities • Markov modeling of repairable and non-repairable systems • Reliability Logic Diagrams • Fault-tree analysis (8) Preventive and Predictive maintenance • Failure Modes and Effects Analysis (4)				
Textbooks	1. Louis Cohen, Joseph P. Ficalora, Quality Function Deployment and Six Sigma: A QFD Handbook, Prentice Hall, 2nd Edition, 2009, ISBN: 9780137035441 2. VNA Naikan, Reliability Engineering and Life Testing, PHI Learning, 2010, ISBN: 978-8120335936 3. Singiresu S Rao, Reliability Engineering, Pearson Education, 2014, ISBN: 978-0136015727				
References	1. Patrick O Connor, Practical Reliability Engineering, John Wiley, 2009, ISBN: 9780470979815 2. B.L. Hansen & P.M. Ghare, Quality Control and Applications, Prentice-Hall, 1997, ISBN: 9780137452255				

Course Title	Product Management	Course No	To be filled by the office		
Specialization	HMC	Structure (IPC)	2	0	2
Offered for	UG and DD	Status (Core / Elective)	Core		
Prerequisite	Entrepreneurship and Management Functions	To take effect from			
Course Objectives	The course provides an introduction to product management with an emphasis on product strategy, product development, product life-cycle management, platform and portfolio management and branding.				
Course Outcomes	This course will equip engineering students with an understanding of 1. The role of product management in a new or established technology enterprise 2. Techniques to price, promote, position and track profitability of product				
Contents of the course	Introduction to Product Management • Core responsibilities of Product Management within an organization • Typical Product Development Process & Product Life Cycle • Key Product Management Concepts ('Value", "Market", "Minimum Viable Product") (4) Product Marketing • Market Research, Market segmentation, Entry strategy • Test marketing, and Tracking New Product Launch • Brand Management (10) Product Strategy, Roadmap and Organization • Corporate strategy & Product strategy • Product Platforms, Product Lines &Product Portfolio Management • Risk Management (market, technology, portfolio) • Organization structures for product management & new product development (8) Product Life Cycle Management Tools & Product Profitability Assessment (8)				
Textbooks	1. Jakki J Mohr and Sanjit Sengupta, Marketing of High-Technology Products and Innovations, 2nd Edition, Pearson Education, 2011, ISBN:978-0136049968 2. John Stark, Product Lifecycle Management: 21st Century Paradigm for Product Realisation, Springer, 2011, ISBN: 9781447126782 3. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, 6th Edition, McGraw-Hill, 2016, ISBN: 978-0070658110				
References	1. Steven Haines, Product managers desk reference, 2nd Edition, McGraw Hill, 2014, ISBN: 978-0071591348.				

Course Title	CNC Technology and Programming	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	DD	Status (Core / Elective)	Core		
Prerequisite	Basic Concepts in Manufacturing Processes	To take effect from			
Course Objectives	A study of the principles, techniques, and applications of computer numerically controlled machine tools. G and M code programming of industrial machines, tooling systems, and an introduction to Computer Aided Manufacturing (CAM) systems will be covered.				
Course Outcomes	At the completion of the course, the student should be able to: • use the appropriate terminology to describe CNC machine tools • explain the basic types of CNC machine tools and the manufacturing operations for which they are best suited • describe the major factors in the development of CNC machines • prepare G and M code programs and documentation for the • manufacturing steps required to produce machined parts on CNC turning and machining centers • develop part programs for machining free form surfaces				
Contents of the course	Basics and need of CNC machines, NC, CNC and DNC systems, Structure, Applications and Advantages of NC machines, CNC Routers. (5) Machine structure and configurations (parallel and serial), Guide ways, Motion transmission elements, Motors, Swarf removal and safety considerations, Automatic tool changers and multiple pallet systems, Sensors and feedback devices, on-machine verification and other accessories, MTConnect, Industrial Internet of CNC Machines, DIY Hardware. (13) Axis identification and coordinate systems, Structure of CNC part program, Programming codes, Programming for 2 and 3 axis control systems, Manual part programming for a turning center, Programming using tool nose radius compensation, Tools offsets, Do loops, sub routines and fixed cycles. Wire-EDM programming, Programming special purpose machine tools. (12) CAD/CAM based part programming. Programming 5 axis machines for Free form machining, Tool path Verification, Tool path optimization, STEP-NC and other standards for CNC, DIY Software. (10) Tooling requirements of CNC machines, Pre-set and qualified tools, Work and tool holding devices in CNC machines. (4)				
Textbooks	1. James V. Valentino and Joseph Goldenberg, Introduction to Computer Numerical Control, 5th edition, Prentice Hall, 2012, ISBN: 978-0132176033. 2. Jon S. Stenerson and Kelly Curran, Computer Numerical Control: Operation and Programming, Prentice Hall, 2006, ISBN: 978-0131115477.				
References	1. Peter Smid, CNC Programming Handbook, 3rd edition, Industrial Press, Inc, 2007. ISBN: 978-0831133474. 2. Peter Smid, CNC Control Setup for Milling and Turning, 1st edition, Industrial Press, Inc, 2010. ISBN: 978-0831133504. 3. Yusuf Altintas, Manufacturing Automation Metal Cutting Mechanics, Machine Tool Vibrations, and CNC Design, 2nd edition, Cambridge University Press, 2012. ISBN: 9780521172479. 4. Alan Overby, CNC Machining Handbook: Building, Programming, and Implementation, 1st edition, McGraw-Hill Education, 2010. ISBN: 978-0071623018.				

Course Title	Computer Aided Design and Manufacturing	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	UG and DD	Status (Core / Elective)	Core		
Pre-requisite	----	To take effect from			
Course Objectives	The objective of this course is to provide the fundamental concepts of computer aided design and manufacturing through geometric modeling and their representations				
Course Outcomes	At the end of the course, a student will be able to • model three-dimensional surfaces and exchange data from one system to another • understand 3D-solid representation techniques • to develop CNC programs for machining complex geometries				
Contents of the course	Overview of CAD/CAM: Hardware and software requirements in CAD/CAM, Introduction to geometric representation- Implicit, explicit, parametric equations; Transformations in 2D and 3D, projections. (8) Parametric curves: Differential geometry of curves, Cubic Hermite curves - Algebraic and geometric form, Blending functions, subdivision, re-parameterization and composite Hermite curves, continuity aspects, Bezier curves - control polygons and Bernstein basis, de Casteljau algorithm, continuity aspects, rational Beziers, B-spline curves - periodic, open and non-uniform knot vectors and corresponding curves, rational B-splines, NURBS curve. (8) Parametric surfaces: Hermite surface - algebraic and geometric form, subdivision and reparameterization, continuity of surfaces, Bezier surface - control net representation, continuity aspects, rational Bezier surfaces, B-Spline surfaces - periodic, open and non-uniform knot vectors and corresponding surfaces, rational B-splines, NURBS surface. (8) Representation of solids: Topology of surfaces, Euler and modified form of equations, representations - Quadtree, Octree, Halfspace, Boundary Representation (B-Rep), Constructive Solid Geometry (CSG), Boolean operations in 2D - set membership classification, Union, Difference and Intersection. (8) Data exchange in CAD/CAM: CNC part programming for ordinary and complex geometry, CNC Program generation from CAD models, Concepts of native and neutral file formats for data exchange, Interfacing with manufacturing systems, Concepts of reverse engineering, Rapid prototyping, Computer aided process planning. (10)				
Textbooks	1. I. Zeid, CAD/CAM Theory and Practice, Tata McGraw Hill, 2006. 2. D. F. Rogers and J. A. Adams, Mathematical Elements for Computer Graphics, McGraw Hill, 2002. 3. C. K. Chua, K. F. Leong, C. S. Lim, Rapid prototyping, World Scientific, 2010. 4. D. F. Rogers, An Introduction to NURBS, Morgan Kaufmann, 2001. 5. J. Hoschek and D. Lasser, Computer Aided Geometric Design, AK Peters, 1996.				
References	1. M. E. Mortenson, Geometric Modeling, John Wiley & Sons, 1985. 2. G. E. Farin, Curves and Surfaces for CAGD, Morgan Kaufmann, 2002.				

Course Title	Microprocessors and Controllers	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	1	3	3
Offered for	UG and DD	Status (Core / Elective)	Core		
Pre-requisite	----	To take effect from			
Course Objectives	To develop good understanding of operating principles/architectures of microprocessor/microcontrollers To gain comprehension and hands on experience of programming techniques with microprocessors and microcontrollers To learn practically the concepts of peripherals interfacing with microprocessors and microcontrollers				
Course Outcomes	At the end of the course, a student will be able to: • Understand binary and hexadecimal number systems • Program the microprocessors/microcontrollers for solving practical problems • Interface memory/keyboard/display etc. with microprocessors/micro controllers and run the devices like stepper motors etc.				
Contents of the course	Binary and Hexadecimal number systems and conversion, Arithmetic and logical operations, Logic gates, Addition, Subtraction, encoder, decoder, multiplexor, de-multiplexor, and concept of memory. Architecture and Programming of 8085 Microprocessor. Interfacing of 8085 with memory and input /output ports, hex keyboards etc., Introduction – Standalone computers versus computers as components – Examples of Embedded computing systems. Elements of embedded controllers such as A/D converters, PWM circuits and timers. Introduction to the 8051 microcontrollers programming and interfacing with A/D, D/A converters, Sensor interfacing and signals conditioning.				
Textbooks	1. M. Morris Mano, Digital Logic and Computer Design, 1st edition, Pearson, 2013. 2. R. Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, 6th edition, Penram, 2013. 3. M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, Microcontroller and Embedded Systems, 2nd edition, Pearson Education, 2009.				
References	1. K. J. Ayala, The 8051 Mocrocontroller, 3rd edition, Thomson Delmar Learning, ISBN-13: 978-1401861582. 2. D. V. Hall, Microprocessors and Interfacing: Programming and Hardware, 2nd edition, McGraw-Hill, Inc., 1990, ISBN-13: 978-0070257429.				

Course Title	Computer Numerical Control Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	DD	Status (Core / Elective)	Core		
Prerequisite	Basic Concepts in Manufacturing Processes	To take effect from			
Course Objectives	To develop an understanding of computer numerically controlled machine tools and skill development in G and M code programming of industrial machines, tooling systems using manual and Computer Aided Manufacturing (CAM) systems.				
Course Outcomes	At the completion of the course, the student will be able to: • write part programs for milling, turning and wire-cut EDM • generate part programs for milling and turning using CAM software. • model free form surfaces and generate tool path for 5-axis machining. • verify and optimize tool path for complex machining operations.				
Contents of the course	Building CNC lathe using CNC kits Building CNC Milling machine using CNC kits Manual Programming for CNC Tuning center Manual Programming for CNC milling machine CNC Parametric Part programming Program generation using CAM software Free form surface modeling and tool path generation Programming for 5-axis machining CNC tool path verification and optimization CNC full machine simulation and verification				
Textbooks	1. P. Smid, CNC Programming Handbook, 3rd edition, Industrial Press, Inc, 2007. ISBN: 978-0831133474.				
References	2. A. Overby, CNC Machining Handbook: Building, Programming, and Implementation, 1st edition, McGraw-Hill Education, 2010. ISBN: 978-0071623018.				

Course Title	Product Design Practice	Course No	To be filled by the office		
Specialization	Design	Structure (IPC)	0	3	2
Offered for	UG and DD	Status (Core / Elective)	Core		
Prerequisite	Design Realization, Product Realization	To take effect from			
Course Objectives	Students will develop cross-discipline products and prototype them using product realization tools in a multi- disciplinary team setting.				
Course Outcomes	By the end of the course, the students would be able to • Develop cross disciplinary idea • conceive, design and prototype an innovative idea • work in cross-functional groups and to apply the concepts learnt in theory to a practical problem • manage group projects, maintain timeliness and follow method oriented approach to problem solving				
Contents of the course	This course is an inter-disciplinary team-based product design and prototyping course. The concept of the course is to provide hands-on learning experience in interdisciplinary fields of engineering and exposure to the context of a "real" product design problems. In this course students will design a product by following the systematic product design process. A team consist of students from different discipline will choose their own innovative product and while designing, students will consider many issues like market opportunities, formal requirements and constraints, the environment in which the product will be used, product look and feel; technical legitimacy, and manufacturing considerations for the products. During the course, students will learn and put in to practice team working, project management and product realization practices commonly found in product developers in industry. Throughout the semester, the student teams have several opportunities to present their progress to their fellow students and faculty.				
Textbooks	1. Carl Liu, Innovative Product Design Practice, Kindle Edition, ASIN: B00B29V9RQ 2. Bjarki Hallgrimsson, Prototyping and Modelmaking for Product Design, Laurance King Publishing Limited, 2012. ISBN-13: 978-1856698764.				

Course Title	Data Analytics	Course No	To be filled by the office		
Specialization	HMC	Structure (IPC)	2	0	2
Offered for	UG and DD	Status (Core / Elective)	Core		
Prerequisite	Measurement and Data Analysis Lab (Probability & Statistics) and Design for Quality and Reliability	To take effect from			
Course Objectives	Data Quality and Analytics plays a crucial role in the increasingly digital world and cyber-physical systems. This course will introduce engineering students to key techniques for deriving meaningful insights from structure & unstructured data, with specific examples derived from the world of design, manufacturing and management.				
Course Outcomes	At the end of the course, students will be familiar with applying known techniques for 1. Data enrichment and integration 2. Descriptive, Inferential, Predictive and Prescriptive analytics				
Contents of the course	Introduction • Introduction to Data and Analytics in a Digital Context (Internet of Things) • Product Data Management for Design and Manufacturing (PLM Tools) • Typical data challenges (data quality, enrichment, integration of ERP & PLM data) • Preparing data for analytics (techniques to improve data quality, integration - ETL) • Advances in data visualization & related tools (4) Statistical Techniques for Analytics • Descriptive Statistics • Inferential statistics • Regression and ANOVA (8) Machine Learning • Algorithmic and model based frameworks • Supervised Learning and Classification Techniques (Discriminant analysis, Neural Nets) • Unsupervised learning and challenges of big data (14) Semantic, contextual and real-time • Semantic enrichment, integration • Semantic reasoning with ontologies (6)				
Textbooks	1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The elements of statistical learning, 2nd Edition, Springer, 2009, ISBN: 9780387848570. 2. Douglas C Montgomery and George C Runger, Applied statistics and probability for engineers, 4th edition, John Wiley & Sons, 2010, ISBN: 9781118539712				
References	1. NPTEL Online course on Data Analytics by IITM (http://nptel.ac.in/courses/110106064/) 2. Batini, Carlo and Scannapieco, Monica, Data Quality Concepts, Methodologies and Techniques, Springer, 2009, ISBN:9783540331728 3. Christopher Tong and D. Sriram, Artificial Intelligence in Engineering Design: Knowledge acquisition, commercial systems, and integrated environments, 1992, ISBN:9780080926025				

Course Title	Advanced Machining Processes	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	DD	Status (Core / Elective)	Core		
Pre-requisite	Basic Concepts in Manufacturing Processes	To take effect from			
Course Objectives	To impart knowledge on the principles of material removal mechanism of advanced machining processes such as mechanical, electro-chemical and thermal. To provide in depth knowledge in selection of advanced machining process to fabricate intricate and complex shapes in difficult to machine material. To provide awareness of advanced finishing processes to achieve submicron/nano surface finish.				
Course Outcomes	Student will be able to evaluate and select suitable manufacturing process for machining advanced materials for wide variety of applications. They will be able to differentiate between conventional processes and non- conventional processes and develop niche applications based on these processes.				
Contents of the course	Introduction: Types of advanced manufacturing processes; Evolution, need, and classification of advanced machining processes. (3) Mechanical Processes: USM, Rotary Ultra Sonic Machining (RUM), AJM, WJM, AWJM processes - Process principle and mechanism of material removal; Process Parameters; Process Capabilities; Applications; Operational characteristics; Limitations. (8) Advanced Fine Finishing Process: Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF), Magneto Rheological Abrasive Finishing (MRAF) - Process principle; Process equipment; Process Parameters; Process Capabilities; Applications; Limitations. (6) Chemical Processes: Process principle and details of Chemical Machining (CHM), Photo-Chemical Machining (PCM), and Bio-Chemical Machining (BCM) processes. (4) Electro Chemical Processes: ECM - Process principle; Mechanism of material removal; Process Parameters; Process Capabilities; Applications, Tool Design, Electro Chemical Deburring (ECDE). (7) Thermal Processes: EDM, Wire Electro Discharge Machining (WEDM), LBM, EBM, IBM, PAM processes – Process principle and mechanism of material removal; Process parameters and characteristics; Surface finish and accuracy, Process Capabilities; Applications; Limitations. (8) Derived and Hybrid: Electro Stream Drilling (ESD), Shaped Tube Electro Machining (STEM), Electro Chemical Honing (ECH), Electro Chemical Discharge Machining (ECDM) - Process Parameters; Process Capabilities; Applications; Limitations, Introduction to form machining. (8)				
Textbooks	1. V. K. Jain, Advanced Machining Processes, 1st edition, Allied Publishers Pvt. Ltd, 2007. ISBN: 978-8177642940.				
References	1. H. Abdel and G. El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, 1st edition, McGraw-Hill Professional, 2005. ISBN: 978-0071453349. 2. G.F. Benedict, Nontraditional Machining Processes, 1st edition, Marcel Dekker Inc., 2002.				

Course Title	Additive Manufacturing	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	DD	Status (Core / Elective)	Core		
Pre-requisite	Basic Concepts in Manufacturing Processes	To take effect from			
Course Objectives	The objective of the course is to impart fundamentals of additive manufacturing processes along with the various file formats, software tools, processes, techniques and applications.				
Course Outcomes	Students will be able to decide between the various trade-offs when selecting AM processes, devices and materials to suit particular engineering requirements. Students will have in-depth knowledge in latest trends and opportunities in AM, including distributed and direct digital manufacturing, mass customization, and how to commercialize their ideas.				
Contents of the course	Introduction to the Basic Principles of Additive Manufacturing, Additive Manufacturing Processes, Extrusion, Beam Deposition. (8) Jetting, Sheet Lamination, Direct-Write, Photopolymerization, Sintering, Powder Bed Fusion (8) Design/Fabrication Processes: Data Sources, Software Tools, File Formats, Model Repair and Validation, Pre- & Post-processing, Designing for Additive Manufacturing, Multiple Materials, Hybrids, Composite Materials, current and future directions. (11) Process & Material Selection, Direct Digital Manufacturing and Distributed Manufacturing, Related Technologies: Mold-making, Rapid Tooling, Scanning. (8) Applications of AM: Aerospace, Automotive, Biomedical Applications of AM. (5) Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing. (4)				
Textbooks	1. Gibson, Rosen, Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing. Springer, 2009.				
References	1. Hopkinson, Hague, Dickens, Rapid Manufacturing: An Industrial Revolution for the Digital Age. Wiley, 2005. 2. Gibson, Advanced Manufacturing Technologies for Medical Applications. Wiley, 2005.				

Course Title	Manufacturing Systems	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	DD	Status (Core / Elective)	Core		
Pre-requisite	Basic Concepts in Manufacturing Processes	To take effect from			
Course Objectives	Students will gain a basic understanding of manufacturing systems and its management, including types of systems, current theories of manufacturing management, including lean thinking, JIT and demand driven manufacturing. Students will be able to develop an understanding of the performance measurement of manufacturing systems through metrics and key performance indicators.				
Course Outcomes	• Students will recognize manufacturing systems, including job shops, flow lines, assembly lines, work cells. • Students will have a basic understanding of performance measurement and management in modern day manufacturing systems. • Students will have a basic understanding of current manufacturing control theories, such as lean thinking, agile, responsive systems and JIT. • 4. Students will be able to analyze manufacturing systems to improve performance of assembly lines and job shops.				
Contents of the course	Introduction, overview, and components of manufacturing systems, Design, operation, and control of manufacturing systems. (6) Types of manufacturing systems, single station cells, manual assembly lines, automated production lines, transfer lines, analysis automated assembly systems. (8) Performance of manufacturing system - productivity, quality, reliability, agility, responsiveness, sustainability, utilization & availability, flexibility, reconfigurability, resiliency, efficiency and effectiveness of manufacturing system, metrics and key performance indicators. (10) Group technology and cellular manufacturing, flexible manufacturing systems, changeable manufacturing systems, Just-In-Time and lean production, automation. (10) Agile/demand driven manufacturing, Quick response manufacturing, world class manufacturing and holonic manufacturing systems. (5) Computer Integrated Manufacturing, Enterprise Integration (ISA-95 and other standards), Digital Manufacturing and smart manufacturing systems. (5)				
Textbooks	1. M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing. 3rd edition, Pearson Education, 2015. ISBN: 978-9332549814. 2. N. Singh, Systems Approach to Computer Integrated Design and Manufacturing, 1st edition, Wiley India, 2011. ISBN: 978-8126530410.				
References	1. G. Chryssolouris, Manufacturing Systems: Theory and Practice. 2nd edition, Springer, 2006. ISBN: 978-1441920676. 2. W. J. Hopp, M. L. Spearman, Factory Physics, 3rd edition, Waveland Press, 2011. 3. E. Turban, L. Volonino, Information Technology for Management: Transforming Organizations in the Digital Economy, 7th edition, Wiley India Private Limited, 2010. ISBN: 978-8126526390. 4. R. Askin and C. Standridge, Modeling and Analysis of Manufacturing Systems, 1st edition, John Wiley, 1992. ISBN: 978-0-471-51418-3.				

Course Title	Design of Experiments Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	DD	Status (Core / Elective)	Core		
Pre-requisite	Engineering Mathematics	To take effect from			
Course Objectives	To learn and implement the concepts design of experiments into practical problems related to design and manufacturing.				
Course Outcomes	At the end of the course, the students will be able to implement the concepts of design of experiments in to practical problems/situations appropriately.				
Contents of the course	About Designing of Experiments: Defining factor constraints, Determining the interaction terms, Determining the number of runs, Checking the design, Gathering and entering the data, Analyzing the results. (3) Custom Designer-Screening experiments, Response surface experiments, Mixture experiments and Use of the custom designer with example. (3) Building Custom Designs-Creating custom design, Creating random block designs, Creating split plot designs, Creating split-split plot designs, Creating strip plot designs and Case studies with implementation. (6) Screening Designs-Screening design examples, Creating screening designs, Placket-Burman designs, Analysis of screening data and Case studies. (3) Response Surface Designs-Box-Behnken design,Creating response surface design and Case studies. (6) Full Factorial Designs-Example and case study. (3) Mixture Designs-Mixture design types, Optimal mixture design, Simplex centroid design, Simplex lattice design and Case studies. (3) Discrete Choice Designs-Discrete choice design example with case study. (3) Space Filling Designs-Sphere packing designs, Latin hypercube designs, Uniform designs andCase studies. (3) Nonlinear Designs-Creating a nonlinear design with case study. (3) Taguchi Designs-Creating Taguchi designs and case study with implementation. (3) Augmented Designs-Creating augmented designs with case study. (3)				
Textbooks	1. SAS Institute Inc., Design of experiments. 2nd edition, 2009. ISBN: 978-1-60764-303-6. 2. L. Eriksson, E. Johansson, N. Kettanah- Wold et al., Design of Experiments Principles and Applications, 3rd edition, Umetric Academy, 2008. ISBN: 978-91-973730-4-4.				
References	1. W.P. Gardiner and G. Gettinby, Experimental Design Techniques in Statistical Practice. 1st edition, Woodhead Publishing Limited, 1998. ISBN: 978-1-898563-35-8. 2. Norman L. Frigon and David Mathews, Practical Guide to Experimental Design, John Wiley & Sons, Inc., 1997. ISBN: 0-471-13919-X 3. Jiju Antony, Design of Experiments, Butterworth-Heinemann, 2003. ISBN: 0-7506-4709-4.				

Course Title	Product Life Cycle Management Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	DD	Status (Core / Elective)	Core		
Pre-requisite	----	To take effect from			
Course Objectives	Demonstrate an understanding of PLM concepts, particularly product data management, change management, workflows and configurations Demonstrate literacy in the application of a PDM tool to support product development processes.				
Course Outcomes	At the end of the course student will be able to use PLM tools for effective product design.				
Contents of the course	Introduction to PLM 3D Solid Modeling in PLM Design Process and Design Intent Parametric Modeling and Features Assembly Modeling Create E-BOM, M-BOM Product Definition Geometry and Information Re-use Modifying and Editing Constraint-based Models Model Based Definition Product Data Management Change Management Product Structure Management Configuration Management				
Textbooks	1. S. M. Samuel, E. D. Weeks, M. A. Kelley, Teamcenter Engineering and Product Lifecycle Management Basics, 1st edition, Design Visionaries, Inc., 2006. ISBN-13: 978-0975437742. 2. A. Saaksvuori, A. Immonen, Product Life Cycle Management, 3rd edition, Springer, 2008. ISBN: 978-3-580-78173-8.				
References	1. J. Stark, Product Lifecycle Management: 21st Century Paradigm for Product Realization, 1st edition, Springer, 2011. ISBN: 978-0-85729-546-0. 2. M. Grieves, Product Lifecycle Management: Driving the Next Generation of Lean Thinking, 1st edition, McGraw-Hill, 2006. ISBN: 0-07-145230-3.				

Course Title	Innovation Management	Course No	To be filled by the office		
Specialization	HMC	Structure (IPC)	2	0	2
Offered for	UG and DD	Status (Core / Elective)	Core		
Prerequisite	Entrepreneurship and Management	To take effect from			
Course Objectives	The objective of this course is to help engineers understand the innovation challenge from the entrepreneur and manager's perspective, i.e., both at a strategic level and organizational level. In other words, how do entrepreneurs and managers build organizations and ecosystems that can continuously generate and commercialize innovations, and how can they protect and enhance competitive advantage				
Course Outcomes	At the end of the course, students will have a familiarity with: • Topics in strategic innovation management, such as innovation networks, idea brokering, open innovation; • Innovation processes and structures such as R&D team, the pros and cons of various R&D organizational structures, and challenges of innovation in large and small firms; • Skills to identify, evaluate, and resolve a variety of issues relating to poor innovative performance in large firms as well as entrepreneurial firms.				
Contents of the course	Exploring innovations • Processes used to explore innovations along the technology, market and strategy dimensions as the innovation moves from idea to market. • Introduction to concepts such as Blue Ocean Strategy, Value Network, Disruptive Innovation, Open Innovation (8) Executing innovations • Structures and incentives to effectively allow talented individuals from different functions to execute innovation processes • Roles such as Chief Innovation or Technology Officer or Technology Evangelist (8) Exploiting innovations • Strategies to effectively exploit the value of innovation, including innovation platforms that include multiple products, portfolios, standards and business models (8) Renewing innovations • Processes, structures and strategies for exploring, executing and exploiting innovations that established firms can use to renew their innovation foundations in the face of potentially disruptive innovations. (8)				
Textbooks	1. Paul Trott, Innovation Management and New Product Development, Pearson, 5th Edition, 2011, ISBN: 9781447916079 2. Joe Tidd and John Bessant, Managing Innovation: Integrating Technological, Market and organizational change, Wiley, 2009, ISBN: 978-1-118-53859-3. 3. Burgelman R. Christensen C., Maidique M., Wheelwright S., Strategic Management of Technology and Innovation. McGraw Hill, 2007, ISBN: 9780071232302.				
References	1. Christensen, Clayton M., The innovator's solution: creating and sustaining successful growth, Harvard Business Press, 2003, ISBN: 9781578518524. 2. Naushad Forbes, and Wield David, From Followers to Leaders - Managing technology and innovation, Routledge, 2002, ISBN: 9780415251754.				

Course Title	Surface Modification Technologies	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	DD	Status (Core / Elective)	Core		
Pre-requisite	Science and Engineering of Materials	To take effect from			
Course Objectives	This is a course on surface engineering to impart knowledge on surface modification methods that will come in handy to improve surface dependent engineering properties such as friction, wear, corrosion and fatigue.				
Course Outcomes	Students will be able to have an insight in the importance of surface engineering to recommend a surface engineering process for various materials and select or utilize a surface engineering process for a given application.				
Contents of the course	Fundamentals of surface engineering: surface dependent properties and failures, mechanism of surface degradation, importance and necessity of surface engineering, surface energy, general principles of surface engineering, classification and scope of surface engineering in metals, ceramics, polymers and composites, tailoring of surfaces of advanced materials. (10) Conventional surface modification methods: changing surface metallurgy - flame hardening, induction hardening, shot peening; changing surface chemistry – aluminum anodizing, oxidation treatments, diffusion coatings such as carburizing, nitriding and cyaniding; adding a surface layer or coating – organic coatings, ceramic coating and linings, hot dip coatings, electrochemical deposition; weld overlay coatings, scope and applications of conventional surface modification methods in engineering materials, advantages and limitations of conventional surface modification methods. (10) Advanced surface modification methods: changing the surface metallurgy - high-energy beam hardening with ion, electron and laser beams, severe plastic deformation; changing the surface chemistry – ion implantation, laser alloying; adding a surface layer or coating – thermal spray coatings, plasma spray coating, cladding, chemical vapor deposition, physical vapor deposition, thermoreactive deposition/diffusion process, functional and nanostructured coatings and their applications in photovoltaics, bio and chemical sensors, surface coatings on polymers and composites. (12) Process comparison and surface characterization methods: process availability, corrosion resistance, wear resistance, distortion or size change tendencies, coating thickness attainable; measurement of coating thickness, porosity, adhesion, residual stresses and stability; testing and evaluation of surface properties by microstructural and compositional characterization of surfaces, structure-property correlation, economics and energy considerations, designing of surface modification processes. (10)				
Textbooks	1. K. G. Budinski, Surface Engineering for Wear Resistance, 1st edition, Englewood Cliffs, New Jersey, Prentice Hass, 1988. ISBN: 0138779376. 2. J. R. Davis (editor), Surface Engineering for Corrosion and Wear Resistance, 1st edition, ASM International, 2001, ISBN: 978-0-87170-700-0.				
References	1. M. Ohring, Materials Science of Thin Films – Deposition & Structure, 2nd edition, Academic Presss, 2002. ISBN-13: 978-0125249751. 2. A. W. Batchelor, N. L. Loh and M. Chandrasekaran, Materials Degradation and Its Control by Surface Engineering, 3rd edition, World Scientific, 2011, ISBN: 978-1-84816-501-4.				

Course Title	Processing of Polymers and Composites	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	DD	Status (Core / Elective)	Core		
Pre-requisite	Science and Engineering of Materials	To take effect from			
Course Objectives	This is a course on processing of polymers and polymer composites to impart knowledge on processing methods that will come in handy to produce polymer and polymer composite components.				
Course Outcomes	Students will be able to have an insight in the manufacturing methods to produce polymer and polymer composite components to recommend a suitable process for production of various fuel efficient components for automobile, ships, aircrafts etc.				
Contents of the course	Fundamentals of polymer engineering: Identification of polymers, arrangement of polymer molecules, copolymers and polymer blends, polymer additives, thermal properties of polymers, rheology of polymer melts. (8) Processing of polymers: Extrusion, mixing processes, injection molding, special injection molding processes, thermoforming, calendering, rotational molding, compression molding, transfer molding. (12) Fundamentals of composite materials: classification of composite materials, Raw materials for composite part fabrication, reinforcements, matrix materials, farbrics, prepegs, performs, molding compound, honeycomb and other core materials. (6) Manufacturing processes for thermoset composites: Prepeg lay-up, Wet lay-up, Spray-up, Filament winding, Pultrusion, Resing transfer molding, Structural reaction injection molding, Compression molding, Roll wrapping, Injection molding. (10) Manufacturing processes for thermoplastic composites: Tape winding, Pultrusion, Compression molding, Hot pressing, Autoclave processing, Diaphragm forming, Injection molding. (8)				
Textbooks	1. T. A. Osswald and G. Menges, Material Science of Polymers for Engineers, 3rd edition, Hanser Publications, Cincinnati, 2010. ISBN: 978-1-56990-514-2. 2. R. J Crawford, Plastics Engineering, 3rd edition, Butterworth-Heinmann, 2006, ISBN: 978-81-312-0174-9. 3. S. K. Mazumdar, Composites Manufacturing: Materials, Product and Process Engineering, 1st edition, CRC Press LLC, New Delhi, 2002. ISBN: 0-8493-0585-3.				
References	1. T. A. Osswald, Polymer Processing Fundamentals, 1st edition, Hanser / Gardner Publications, 1998. ISBN-13: 9781569902622. 2. A. B. Strong, Fundamentals of Composites Manufacturing: Materials, Methods and Applications, 2nd edition, Society of Manufacturing Engineers, Michigan, 2008, ISBN: 978-087263854-9.				

Course Title	Advanced Manufacturing Processes Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	DD	Status (Core / Elective)	Core		
Pre-requisite	Basic Concepts in Manufacturing Processes	To take effect from			
Course Objectives	Students will gain a practical knowledge of various manufacturing processes in a hands-on environment through experiments and simulations.				
Course Outcomes	At the end of the course, a student will be able to: • Study cutting forces in machining processes • Develop a practical understanding of advanced manufacturing processes. • Identify and rectify defects in parts and manufacturing processes related problems. • Simulate flow of molten polymer materials to identify the problems in injection moulding processes.				
Contents of the course	Measurement of Cutting Force and Temperature in Turning Experiments on Wire-EDM Experiments on Laser Beam Machining Design and manufacture of products using Additive Manufacturing Study of Temperature distribution in arc welding Weld quality tests Part to CAD comparison using contact/non-contact digitization methods Sheet metal bending experiments Mechanical properties of powder compacts Experiments on Rolling, Deep Drawing, Extrusion Mold Flow simulation for Injection molding process planning Design and representation of assembly of objects. Assembly sequencing, disassembly sequencing.				
Textbooks	1. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. ISBN: 978-1-118-47420-4. 2. E. P. DeGarmo, J. T. Black, R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2011. ISBN: 978-0470924679.				
References	1. S. Kalpakjian, and Schmid, Manufacturing processes for engineering materials, 5th edition, Pearson education, 2010. ISBN: 978-0132272711.				