B.Tech. Smart Manufacturing

Syllabus

Syllabus of B.Tech Mechanical-Smart Manufacturing (MSM) 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.

<table>
<tr><td>Course Title</td><td>Computational Engineering</td><td>Course No
(will be assigned)</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Computer Engineering</td><td>Structure (LTPC)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Faculty</td><td></td><td>Type</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td>To take effect from</td><td colspan="4"></td></tr>
<tr><td>Submission date</td><td>March 2014</td><td>Date of approval by Senate</td><td colspan="4"></td></tr>
<tr><td>Objective</td><td colspan="6">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.</td></tr>
<tr><td>Contents of the course</td><td colspan="6">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)</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 7th Edn, 2012.</td></tr>
<tr><td>References</td><td colspan="6">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.</td></tr>
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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.					

<table>
<tr><td>Course Title</td><td>Engineering Skills Practice</td><td>Course No
(will be assigned)</td><td colspan="4"></td></tr>
<tr><td>Specialization</td><td>Interdisciplinary</td><td>Structure (LTPC)</td><td>0</td><td>0</td><td>3</td><td>2</td></tr>
<tr><td>Offered for</td><td>UG & DD</td><td>Status</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Faculty</td><td></td><td>Type</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td>----</td><td>To take effect from</td><td colspan="4"></td></tr>
<tr><td>Submission date</td><td>March 2014</td><td>Date of approval by Senate</td><td colspan="4"></td></tr>
<tr><td>Objectives</td><td colspan="6">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.</td></tr>
<tr><td>Contents of the course</td><td colspan="6">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.</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Uppal S. L., “Electrical Wiring & Estimating”, 5Edn, Khanna Publishers, 2003.
2. Chapman. W. A. J., Workshop Technology, Part 1 & 2, Taylor & Francis.</td></tr>
<tr><td>References</td><td colspan="6">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.</td></tr>
</table>

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				
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 – Smart Manufacturing for 3rd to 8th Semesters

(According to 32nd and 33rd Senate meeting minutes)

<table>
<tr><td>Course Title</td><td>Probability and Statistics</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Mathematics</td><td>Structure (IPC)</td><td>3</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>B. Tech. MSM</td><td>Status (Core / Elective)</td><td colspan="3">Core</td></tr>
<tr><td>Prerequisite</td><td></td><td>To take effect from</td><td colspan="3"></td></tr>
<tr><td>Course Objectives</td><td colspan="5">To impart knowledge of probabilistic and statistical concepts, tools and techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">1. The student will be comfortable with probabilistic and statistical ideas in engineering applications
2. The student will be capable of learning advanced, specialized materials from the domain as required.</td></tr>
<tr><td>Contents of the course</td><td colspan="5">Introduction to probability – sample spaces and axioms, conditional probability, independence, counting techniques and Baye’s theorem, analysis of success and failure rates.
Discrete and continuous random variables, analytical models of random phenomena, probability and mass density functions of a few standard discrete and continuous distributions: binomial, Poisson, normal and their relevance in engineering through case studies
Concepts of mean, variance; Moment generating functions, the law of large numbes and the central limit theorem
Purpose and nature of the sampling, point estimates and interval estimates, maximum likelihood principle approach
Linear regression, correlation, covariance and confidence intervals
Sampling analysis, formulation and testing of hypotheses – simple case studies in inspection and quality control
Criteria for acceptance of hypothesis: t-test, chi-squared test.</td></tr>
<tr><td>Textbook</td><td colspan="5">1. D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, 4th edition, Wiley India, 2007.
2. R. A. Johnson, C. B. Gupta, Miller and Freund’s, Probability and Statistics for Engineers, 7th edition, Pearson Prentice-hall, 2005</td></tr>
<tr><td>Reference</td><td colspan="5">1. J. Devore, Probability for Engineering and the Sciences, Brookes/cole Cengage Learning, e-book, 2010.
2. J. Milton and J. C. Arnold, Introduction to Probability and Statistics, 4th edition, Tata McGraw-Hill, 2002.
3. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 10th edition, 2000.</td></tr>
</table>

Course Title	Engineering Economics	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	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	• 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				
Textbooks	1. J. A. White, K. S. Grasman, K. E. Case, K. L. Needy, D. B. Pratt, Fundamentals of Engineering Economic Analysis, 1st edition, Wiley, 2014. 2. C. S. Park, Contemporary Engineering Economics, Prentice Hall of India, 2002.				
References	1. B. Tarquin, Engineering Economy, 6th edition, McGraw-Hill, 2005.				

Course Title	Data Structures and Algorithms	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	B. Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	1. To design and implement arrays, stacks, queues, linked lists, trees and graphs 2. To understand the importance of algorithm and analyze its complexity (time and space) 3. To design and implement various programming paradigms and its complexity				
Course Outcomes	1. Ability to write programs to implement stacks, queues, linked lists 2. Application of trees and graphs in real world scenarios 3. Technical knowhow on the implementation of sorting searching algorithms				
Contents of the course	Development of Algorithms - Notations and analysis - Storage structures for arrays - Sparse matrices - Stacks and Queues: applications. Applications of linked lists - Operations on polynomials - Doubly linked lists - Circularly linked lists - Dynamic storage management - Garbage collection and compaction. (9) Binary Trees - Binary search trees - Tree traversal - Expression manipulation - Height balanced trees - AVL trees. Hashing- Priority queue-Heaps Graphs - Representation of graphs - BFS, DFS - Topological sort - Shortest path problems, Pattern matching. (9) Sorting Techniques – Divide and Conquer – Merge – Quick sort; Heap sort, Counting sort and Radix sort. (8) Introduction to Algorithmic Paradigms: Dynamic programming; case studies such as Fibonacci, optimal BST, knapsack, matrix chain multiplication, etc. (8) Introduction to Greedy Algorithms: Container Loading, 0/1 Knapsack, minimum spanning tree, etc. (8)				
Textbook	1. S. Sahni, Data Structures, Algorithms and Applications in C++, Universities Press India Private Limited.				
References	1. T. Corman, C.E.Leiserson, R.L.Rivest, C.Stein, Introduction to Algorithms, Third Edition, Prentice Hall, 2010. 2. J. P. Tremblay and P. G. Sorenson, An Introduction to Data Structures with applications, 2nd edition, Tata McGraw Hill, 1981 3. M. Tenenbaum and Augestien, Data Structures using C, 3rd edition, Pearson Education, 2007.				

Course Title	Thermal Concepts for Manufacturing Engineers	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B. Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	In this course, undergraduate engineering students will be taught the basic concepts of thermal sciences, which are essential for various applications in manufacturing technology.				
Course Outcomes	Students will gain understanding and develop ability to apply knowledge of fluid flow and heat transfer to manufacturing processes and equipments.				
Contents of the course	Steady state heat conduction: Fourier's law of heat conduction, one-dimensional heat transfer, thermal contact resistance, composite wall and electrical analogy, heat flow through cylinder and sphere, critical thickness of insulation. (6) Transient heat conduction: Systems with negligible internal resistance (lumped systems), heat flow in an infinitely thick plate, heat balance integrals. (6) Numerical method (finite difference) for solving multi-dimensional and transient heat conduction problems. (4) Fluid dynamics – Basic governing equations, boundary layer concept, dimensional analysis, turbulent flows. (8) Forced convection, free convection, radiation in non-participating media. (8) Applications of thermal concepts: Heat transfer through extended surfaces, heat exchangers. (10)				
Textbooks	1. T. L. Bergman, A. S. Lavine, F. P. Incropera and D. P. DeWitt, Engineering Thermodynamics, 5th edition, McGraw Hill Education (India) Private Limited, 2013.				
References	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.				

Course Title	Manufacturing Processes - I	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B. Tech. MSM	Status (Core / Elective)	Core		
Prerequisite	Science and Engineering of Materials	To take effect from			
Course Objectives	To study the fundamentals of manufacturing processes and equipments.				
Course Outcomes	Students will gain knowledge of manufacturing processes and the skills to develop and manipulate the operating parameters for a given process to avoid defect and improve quality. Students will gain knowledge to understand basic parts and assemblies manufactured using powered and non-powered machine shop equipment in conjunction with mechanical documentation.				
Contents of the course	Molding Practices: Introduction to casting and foundry industry; basic principles of casting processes; sequencein foundry operations; patterns; molding practice; ingredients of molding sand and coresand, sand testing; different molding processes. (3) Melting Furnaces: Types of furnaces used in foundry; furnaces for melting; melting practice for steel, cast iron, aluminum alloys, copper alloys and magnesium alloys; safety considerations; fluxing, degassing and inoculation. (3) Special Casting Techniques: Investment casting, Shell molding ,die casting, centrifugal casting, plaster mould casting, magnetic casting, squeeze casting, full mould process, strip casting, CO_2 molding. (3) Gating system design: Concept of solidification, directional solidification, role of chilling, principles of gating and risering systems: types and design calculations. (3) Casting Defects and Foundry Automation: Defects in castings and its remedies. Energy saving and quality control in foundries; Cleaning and inspection of castings; Foundry automations-moulding machines-automation of sand plant, moulding and fettling sections of foundry – Dust and fume control. (3) Theory of Plasticity: Theory of Plasticity - stress tensor – hydrostatic & deviator components of stress – flow curve – true stress strain – yielding criteria – yield locus – octahedral shear stress and shear strains – invariants of stress strain – slip line field theory plastic deformations of crystals. (3) Plastic Forming of Metal Forging: Basics of plastic forming & forging- mechanics of metal working – temperature in metal working – strain rate effects – friction and lubrication – deformation zone geometry. Forging process – classification – equipment – calculation of forging loads – forging defects – residual stresses. (3) Plastic Forming of Metals-Rolling and Extrusion: Rolling and Extrusion – classification -rolling mills - rolling of bars & shapes – rolling forces – analysis of rolling – defects in rolling- theories of hot & cold rolling – torque power estimation. Extrusion: classification-equipment – deformation lubrication and defects – analysis – hydrostatic extrusion – tube extrusion. (3) Plastic Forming of Metals - Drawing and Sheet metal forming: Drawing & Sheet Metal Forming- rod & wire drawing equipment – analysis – deep drawing – tube drawing – analysis, residual stresses sheet metal forming – methods – shearing and blanking – bending – stretch forming – deep drawing – forming limit				

	criteria – defects - Stretch forming – press brake forming – explosive forming. (3) Unconventional Forming Methods: Electro hydraulic forming – magnetic pulse forming – super plastic forming – electro forming – fine blanking – P/M forging-Isothermal forging – HERF. (3) Power Sources: Classification of welding processes - heat sources, power sources, arc characteristics, V-I relationship, different types of electrodes, ingredients and function of electrode coverings, types of weld joints. (3) Fusion Welding processes: Shielded metal arc welding, gas welding, TIG welding, MIG welding, Submerged arc welding processes. (3) Solid State Welding processes: Resistance, friction, friction stir, ultrasonic, induction pressure, diffusion welding processes, explosive welding. (3) Special Welding Processes: Electron beam, laser beam welding, plasma arc processes; advantages, limitations, Introduction to Robotic welding, underwater welding. (3) Weld Metallurgy: Weld thermal cycles and their effects, effects of pre and post weld heat treatments, concept of HAZ, concept of weldability and its assessment. Welding of different materials, defects in welds, their causes and remedies. (3)
Textbooks	1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741. 2. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. 978-8126547371.
References	1. E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013. ISBN: 978-8126540464 2. B. Wulff, H. F. Taylor and M. C. Fleming, Foundry Engineering, Wiley Eastern, 2009. 3. American Welding Society, Welding Handbook, AWS, 2009. 4. G. E Dieter, Mechanical Metallurgy, Tata McGraw Hill, 2007.

Course Title	Manufacturing Processes Practice - I	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	B. Tech. MSM	Status (Core / Elective)	Core		
Prerequisite	Design Realization	To take effect from			
Course Objectives	To perform experiments on fundamental manufacturing processes to understand the process, equipment, tooling and set-up involved in these processes.				
Course Outcomes	Students learn to use production machines and equipment to make products using multiple manufacturing processes, coupled with inspection per engineering drawings. Processes include assembly, casting, forming, welding, and injection molding, performed manually and/or via computer programming. Students will be able to perform basic shop floor operation and prepare documents used for monitoring and controlling part production.				
Contents of the course	Study of the shrinkage behavior during phase change processes Molding properties of sodium silicate bonded sand Study of Manual Metal Arc Welding, Gas Metal Arc Welding (GMAW) & Gas Tungsten Arc Welding processes Study on brazing and friction stir welding Study of Sheet metal forming processes Study on the springback in forming processes Study of injection molding process Study on process control and optimization in welding and casting				
Textbooks	1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741 2. E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013. ISBN: 978-8126540464				
References	1. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. ISBN: 978-8126547371				

Course Title	Production Drawing and Manufacturability Analysis	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	1	3	3
Offered for	B. Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	Develop the necessary skills to prepare production drawings and 3D modelling.				
Course Outcomes	At the end of the course, a student will be able to: 1. Develop production drawings with thorough understanding of drafting symbols and GDT. 2. Create assembled and exploded views of machine components. 3. Analyze the machine component for its manufacturability, environmental impact and ease of assembly.				
Contents of the course	1. 2D drafting and 3D modelling of machine components. 2. Use of geometric and dimensional tolerance. 3. Preparation of production drawing using drafting symbols. 4. Developing 3D models using digitizing tools and tolerance analysis 5. Manufacturability studies				
References	1. G. Bertoline, E. Wiebe, N. Hartman and W. Ross, Technical Graphics Communication, 4th edition, Tata McGraw Hill, 2008. 2. G. Boothroyd, P. Dewhurst and W. A. Knight, Product Design for Manufacture and Assembly, 3rd edition, CRC Press, 2010.				

Course Title	Electrical Drives	Course No	To be filled by the office		
Specialization	Electronic Engineering	Structure (IPC)	1	3	3
Offered for	B.Tech. (MDM, MSM), DD (MPD, MFD)	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
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	Experiments conducted in this course bring 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.				
Textbooks	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	Data Structures and Algorithms Practice	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	1. To analyze the time and space complexities and efficiency of various algorithms. 2. To understand the practical application of linear and nonlinear data structures. 3. To introduce and practice advanced algorithms, programming techniques necessary for developing sophisticated computer application programs.				
Course Outcomes	1. Ability to apply and implement the learned algorithm for problem solving 2. Ability to identify the data structure to develop program for real time applications				
Contents of the course	• C programming involving arrays, stacks, queues, strings, linked lists, trees, graphs. • Operations on stacks, queues and linked lists • Conversion of infix expressions to postfix and evaluation of postfix expressions Implementation of priority queue • Implementation of Binary Tree and Binary Search • Tree Implementation of Sorting Techniques • Implementation of case studies that involve algorithmic paradigms such as greedy and dynamic programming.				
Textbooks	1. S. Sahni, Data Structures, Algorithms and Applications in C++, Universities Press India Private Limited.				
References	1. T. Corman, C.E.Leiserson, R.L.Rivest, C.Stein, Introduction to Algorithms, Third Edition, Prentice Hall, 2010. 2. J. P. Tremblay and P. G. Sorenson, An Introduction to Data Structures with applications, 2nd edition, Tata McGraw Hill, 1981 3. M. Tenenbaum and Augestien, Data Structures using C, 3rd edition, Pearson Education, 2007.				

Course Title	Operations and Supply chain Management	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	The course aims to provide an in-depth coverage of operations management and supply chain management. Students will be exposed to various aspects such as production planning, forecasting, regression analysis, transportation models, topics in supply chain etc.				
Course Outcomes	The course would equip students with skills required for effective decision making and management.				
Contents of the course	Operations Management: Introduction, Types of Production Systems Forecasting methods- Qualitative methods, Quantitative models-Time series forecasting models, moving averages, exponential smoothing with trend and seasonal adjustment, multi-item forecasting, Simple and multiple linear regression models Materials Requirement Planning – Waiting line models - Queuing characteristics and terminology, single server and parallel server models, Introduction to discrete event simulation. Network Design in Supply Chain: Introduction to Supply chain, Role of distribution in supply chain –network design in the supply chain –models for facility location and capacity allocation – Impact of uncertainty on network design. Inventory Management in Supply Chain: Cycle inventory – multi-echelon inventory – safety stock in the supply chain – safety level estimation, supply uncertainty, data aggregation, replenishment policies, managing safety, inventory in practice – product availability – optimal level, affecting factors, supply chain contracts. Transportation in Supply Chain: Design options for Transportation network, trade-offs, Risk management in Transportation. Information Sharing in Supply Chain: DSS for supply chain management- Value of information – Bullwhip effect, information and supply chain technology				
Textbooks	1. S. L. Davi, K. Philip and S. L. Edith, Designing and Managing the Supply Chain, Tata McGraw-Hill, 2003. 2. R. Panneerselvam, Production and operations management, Prentice-Hall of India, 2010.				

Course Title	Database Management Systems	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	The focus of this course is on database design, architecture, and relational models.				
Course Outcomes	Learner would appreciate the systematic design and principles involved in any database development.				
Contents of the course	Introduction to Database Systems, Database System Architecture, Schema, Database Models, Relational Model, ER Modelling and case studies. (10) Expressive power of relational databases, Relational Algebra. (6) Database Languages, DDL, DML, Query Languages, case studies. (10) Transaction Processing and Concurrency control. (5) Internal schema Design, Indexing, Introduction to advanced concepts, XML, Datamining, Datawarehousing. (5) Problem sessions, hands on query languages. (6)				
Textbooks	1. R. Elmasri and S. B. Navathe, Fundamentals of Database Systems, 4th edition, Pearson, 2007.				
References	1. A. Silberschatz, H. F. Korth, and S. Sudharsan, Database System Concepts, 5th edition, Tata McGraw Hill, 2006. 2. C. J. Date, A. Kannan, and S. Swamynathan, An Introduction to Database Systems, 8th edition, Pearson, 2006. 3. L. Koch, Oracle – The complete reference, Tata McGraw Hill, 2002				

Course Title	Manufacturing Processes - II	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite	Science and Engineering of Materials, Manufacturing Processes - I	To take effect from			
Course Objectives	To study the fundamentals of machining processes and machine tools.				
Course Outcomes	Students will gain knowledge of machining processes and machine tools. Students will gain knowledge to understand secondary finishing processes in addition to primary machining processes.				
Contents of the course	Mechanism and Cutting tool nomenclature: Importance of material removal, elements of metal machining, fundamental mechanism of metal deformation in cutting. Geometry & design of single point tool, geometry & design of milling cutters, geometry of drills, broacher. (6) Mechanics of Chip Formation: Orthogonal & oblique cutting, mechanism of chip formation, shear plane angle, shear stress and strain, principal chip types, mechanics of machining, forces in cutting of metals, stress on tool, stress distribution, Basic requirement of cutting force measuring technique, Dynamo-meters for measuring forces in turning, milling and drilling. (6) Heat flow in metal cutting and tool life: Introduction, heat in chip formation, heat at tool work interface, heat at tool chip interface, heat in absence of flow zone, method of tool temperature measurement, temperature distribution in tool. Definition, evaluation of machinability, tool life, Taylor's equation, tool failure, variab1es affecting the tool life causes of tool failures, economics in metal machining. (6) Cutting Tool material and Cutting life: Requirement of tool material, effect of alloying elements in properties of tool steel, common tool material, carbon steel , high speed steels, co-cast alloys, carbide tools, ceramic tools, diamond, design & performance of tool material. Function & requirement of cutting fluid, type of cutting fluid as gas, water & oil based solutions, chemical coolants, method of, application of cutting fluid - Minimum quantity lubrication. (6) Abrasive Processes and Broaching: Abrasive processes, grinding wheel - specifications and selection, types of grinding process, cylindrical grinding, surface grinding, centreless grinding and internal grinding, concepts of surface integrity, broaching machines, broach construction - push, pull, surface and continuous broaching machines. (6) Processing of Powder metals, Ceramics, Glass and Super conductors: Production of metal powders, Compaction of metal powders, sintering, design and consideration and process capabilities, shaping of ceramics, forming, shaping and machining of ceramics, processing semiconductors. (6) Processing of Plastics and composite materials: Extrusion, Injection moulding, Blow molding, Rotational molding, Thermoforming, compression molding, transfer molding, casting, cold forming and solid phase forming,				

	processing elastomers, processing metal matrix composites, processing ceramic-matrix composite. (8)
Textbooks	1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741. 2. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. ISBN: 978-8126547371.
References	1. E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013. ISBN: 978-8126540464. 2. D. A. Stephenson, and J. S. Agapiou, Metal cutting theory and practice, CRC Press, 2005.

Course Title	Sensors and Controls	Course No	To be filled by the office		
Specialization	Electronic Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. 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 1. understand the working principle of various sensors. 2. calibrate a sensor for acquiring data. 3. 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 pick ups, 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 and 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 and J. H. Lienhard V., 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 and N. Xi, Control in Robotics and Automation: Sensor-Based Integration, Academic Press, 1999, ISBN: 978-0-12-281845-5 6. C.W. de Silava, Sensors and Actuators, 2nd edition, CRC Press, 2016.				

Course Title	Sensors and Controls Practice	Course No	To be filled by the office		
Specialization	Electronic Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. and DD	Status (Core / Elective)	Core		
Prerequisite		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: 1. Select a suitable sensor for a particular instrumentation task. 2. Calibrate a sensor and to integrate it with signal conditioning and data acquisition systems. 3. 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 and 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 and J. H. Lienhard V., 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 and N. Xi, Control in Robotics and Automation: Sensor-Based Integration, Academic Press, 1999, ISBN: 978-0-12-281845-5 6. C.W. de Silava, Sensors and Actuators, 2nd edition, CRC Press, 2016.				

Course Title	Manufacturing Processes Practice - II	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	To study and practice the various operations that can be performed in lathe,milling machines etc. and to equip with the practical knowledge required in the core industries.				
Course Outcomes	At the end of this course the student should be able to understand 1. Methods to solve problems on cutting forces, tool life and analytical methods of estimating cutting temperature. 2. Constructional features of lathe, drilling, shaper, planer, boring, broaching, and grinding machines, accessories and common operations performed on these machines. 3. Machine tool structures, erection and testing of machine tools 4. Concept of automation of machine tools.				
Contents of the course	Lathe Exercises Machining and Machining time estimations for 1. Taper Turning 2. External Thread cutting 3. Internal Thread Cutting 4. Eccentric Turning 5. Knurling 6. Square Head Shaping 7. Hexagonal Head Shaping Milling Machine Exercises Simple prismatic parts, Contour milling using vertical milling machine, Spur gear cutting in milling machine and Helical Gear Cutting in milling machine Grinding Exercises: Plain Surface grinding, Cylindrical grinding Measurement of cutting forces in Milling / Turning Process EDM, Laser cutting and Rapid Prototyping				
Textbooks	1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741 2. E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013. ISBN: 978-8126540464				
References	1. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. ISBN: 978-8126547371				

Course Title	Machine to Machine Communication Practice	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	1	3	3
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	to teach the students fundamental requirements and challenges of machine-to-machine (M2M) communication and how to integrate such technology into existing infrastructure.				
Course Outcomes	Students can able to Identify the main challenges associated with M2M Communications today, can able to list the main standards, protocols, algorithms, and research activities which address these challenges of today. Can able to identify limits of standards/protocols and algorithms with respect to M2M communications				
Contents of the course	Introduction to M2M; M2M Current Landscape; Early implementations and deployment of M2M communications. (2) M2M Architecture and Protocols –M2M Requirements and High Level Architectural Principles. High Level Architecture Principles for M2M Communications. (3) M2M Service Architectures – High Level Service Architecture; ETSI TC M2M Service Capabilities Framework, M2M service Capabilities, M2M Resource based M2M Commuication and Procedures. (2) M2M Terminals and Modules – Hardware Interfaces – Power, USB, UART, Antenna, UICC, GPIO, SPI, I2C, ADC, PCM, PWM and Analog Audio, Service, Software Interface. (4) Smart Cards in M2M Communication – Security and Privacy issues in M2M communication, hardware based security solutions, Smart Card Properties for M2M environments. (3)				
Textbooks	1. D. Boswarthick, O. Elloumi, and O. Hersent, M2M Communications - A System Approach, Wiley**,** ISBN 978-1-119-99475-6. 2. C. Anton-Haro, M. Dohler, Machine-to-Machine (M2M) Communications-Architecture, Performance and Applications, Woodhead, ISBN 978178242102. 3. D. Minoliauth, Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications, Wiley, ISBN: 978-1-118-47347-4.				
References	1. O. Hersent, D. Boswarthick and O. Elloumi, The Internet of Things: Key Applications and Protocols, Wiley, 2nd edition, 2012, ISBN: 978-1-119-99435-0. 2. J. Brazell, L. Donoho, J. Dexheimer, R. Hanneman and Langdon, M2M The Wireless Revolution, technical report, Innovation - Creativity – Capital Institute**,** University of Texas at Austin. 3. W. Webb, Understanding Weightless Technology, Equipment, and Network Deployment for M2M Communications in White Space, Cambridge, ISBN-13: 9781107027077.				

<table>
<tr><td>Course Title</td><td>Entrepreneurship and Management Functions</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>HMC</td><td>Structure (IPC)</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Offered for</td><td>B. Tech. and DD</td><td>Status (Core / Elective)</td><td colspan="3">Core</td></tr>
<tr><td>Prerequisite</td><td>Systems Thinking and Design</td><td>To take effect from</td><td colspan="3"></td></tr>
<tr><td>Course Objectives</td><td colspan="5">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.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">At the end of the course, the students will learn how to
• Understand the market & competition
• Prepare a business case for the product/idea</td></tr>
<tr><td>Contents of the course</td><td colspan="5">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)</td></tr>
<tr><td>Textbooks</td><td colspan="5">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.</td></tr>
<tr><td>References</td><td colspan="5">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.</td></tr>
</table>

Course Title	Manufacturing Systems	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MSM, DD MFD	Status (Core / Elective)	Core		
Prerequisite	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	1. Students will recognize manufacturing systems, including job shops, flow lines, assembly lines, work cells. 2. Students will have a basic understanding of performance measurement and management in modern day manufacturing systems. 3. Students will have a basic understanding of current manufacturing control theories, such as lean thinking, agile, responsive systems and JIT. 4. 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	Robotics and Automation	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	This course synthesizes the disciplines of Mechanical and Electrical Engineering to provide a comprehensive overview of the various technologies and tools used to develop mechatronic devices.				
Course Outcomes	At the end of the course, a student will be able to 1. integrate various electromechanical devices in manufacturing. 2. automate a manufacturing system with various sensors, actuators and controllers.				
Contents of the course	Mechatronic and Measurement Systems: Overview of mechatronic systems and devices in manufacturing, overview of sensors, transducers and control systems in manufacturing, Elements and Analysis of Electric Circuits, Diode, transistor, and thyristor Circuits, operational Amplifier (Op-Amp) Circuits, digital Logic and logic Families (15) Data Monitoring using Arduino: Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Analog-to-Digital (A/D) and Digital-to-Analog (D/A) Conversion - Analog input / output, Programming and interfacing with Sensors in manufacturing applications. (16) 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. (13)				
Textbooks	1. A. Smaili and F. Mrad, Applied Mechatronics, 1st edition, Oxford University Press, 2007. ISBN: 9780195307023. 2. J. Nussey, Arduino for Dummies, 1st edition, Wiley, 2013. ISBN: 9781118446379. 3. M. P. Groover, Industrial Robotics: Technology, Programming and Applications, 2nd edition, McGraw- Hill, 2012. ISBN: 9780070265097.				
References	1. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th edition, Pearson India, 2008. ISBN: 9788131732533. 2. D. G. Alciatore, M. B. Histand, Introduction to Mechatronics and Measurement Systems, 3rd edition, Tata Mcgraw Hill Education, 2007. ISBN: 9780070648142.				

Course Title	Quality Engineering	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
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	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)				
Textbooks	1. T. G. Beckwith, R. D. Marangoni and J. H. Lienhard, Mechanical Measurements, 6th edition, Pearson Higher Education, 2007, ISBN: 0132296071. 2. R. K. Jain, Engineering Metrology, Khanna Publishers, 20th Reprint, 2014, ISBN: 817409153X.				
References	1. D. J. Whitehouse, Hand book of surface and nanometrology, 2nd Edition, CRC Press, 2010, ISBN: 9781420082012. 2. G. T. Smith, Industrial Metrology, Springer, 2002, ISBN: 9781852335076. 3. A. M. Badadhe, Metrology and Quality Control, Technical Publications, 2006, ISBN: 8189411861. 4. R. C. Gupta, Statistical Qualtiy Control, 8th edition, Khanna Publishers, 2008, ISBN: 8174091114.				

Course Title	Mechanical Design Concepts	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite	Engineering Mechanics	To take effect from			
Course Objectives	This is a basic course on mechanical engineering design focusing on the principles of design, load analysis, stress analysis and final failure analysis of mechanical systems.				
Course Outcomes	Students would be able to apply basic concepts related to mechanical design to design various mechanical systems in aerospace, automotive, naval, wind energy, chemical (nuclear) reactor, oil exploration, solid and fluid transportation.				
Contents of the course	Kinematics and Dynamics: Introduction to mechanisms; position, velocity and acceleration of planar mechanisms; dynamics of planar mechanisms; case studies.(12) Stress and Strain – axially loaded members; torsion of circular bars; bending of prismatic beams. (8) Failure Theories – failure of ductile and brittle materials under static loading; mechanism of fatigue failures; fatigue failure models; Influence of various factors in design against fatigue; case studies. (8) Machine Elements – Design of nonpermanent joints - threaded fasteners, mechanics of power screws; Design of permanent joints – welding; gears – nomenclature, force analysis, Lewis bending equation, design of spur and helical gears. (14)				
Textbooks	1. R. L. Norton, Machine Design – an integrated approach, 5th edition, Pearson education Inc., 2014. ISBN-13: 9780133356717. 2. J. E. Shigley, C. R. Mischke and R. G. Budynas, Mechanical Engineering Design, 7th edition McGraw-Hill, 2004. ISBN-13: 978-0071232708.				
References	1. R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, 5th edition, Wiley-India, 2011. ISBN-13: 978-1118012895. 2. M. F. Spotts, T. E. Shoup and L. E. Hornberger, Design of Machine Elements, 8th edition, Pearson education Inc., 2003. ISBN-13: 9780130489890. 3. A. K. Mallik, A. Ghosh and G. Dittrich, Kinematic analysis and synthesis of mechanisms, 1st edition, CRC Press, ISBN: 0-8493-9121-0.				

Course Title	Robotics and Automation Practice	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	0	3	2
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	This course synthesizes the disciplines of Mechanical and Electrical Engineering to provide a comprehensive overview of the various technologies and tools used to develop mechatronic devices.				
Course Outcomes	At the end of the course, a student will be able to 1. Apply various sensors, transducers etc. in a manufacturing system. 2. Manufacturing system automation using Arduino or Raspberry Pi.				
Contents of the course	Integration of various sensors, actuators and other mechatronic devices in manufacturing applications. Computer based design and simulation of the electromechanical system using Matlab or Labview. Design, develop and integrate the sensors to interface with Arduino or Raspberry Pi.				
Textbooks	1. A. Smaili and F. Mrad, Applied Mechatronics, 1st edition, Oxford University Press, 2007. ISBN: 9780195307023. 2. J. Nussey, Arduino for Dummies, 1st edition, Wiley, 2013. ISBN: 9781118446379. 3. M. P. Groover, Industrial Robotics: Technology, Programming and Applications, 2nd edition, McGraw- Hill, 2012. ISBN: 9780070265097.				
References	1. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th edition, Pearson India, 2008. ISBN: 9788131732533. 2. D. G. Alciatore, M. B. Histand, Introduction to Mechatronics and Measurement Systems, 3rd edition, Tata Mcgraw Hill Education, 2007. ISBN: 9780070648142.				

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, MSM), DD (MPD, MFD)	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
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	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, 8th Edition, Khanna Publishers, 2008.				

Course Title	Embedded Systems Practice	Course No	To be filled by the office		
Specialization	Electronic Engineering	Structure (IPC)	1	3	3
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	To provide a hands-on introduction to design of embedded systems hardware and software, and interfacing in real-time to networked cyber-physical systems.				
Course Outcomes	1. Understand the basic elements of embedded systems such as I/O and interfaces. 2. Understand embedded system design using the ARM Cortex-M microcontroller with the Launchpad IDE in C. 3. Rapid prototyping of embedded systems using open source microcontrollers. 4. Introduction to advanced concepts such as networking and wireless communications, real-time operating systems and control, and Internet of Things.				
Contents of the course	Implementation of embedded systems: Embedded systems design using ARM microcontrollers, Real-time interfacing and operating systems Rapid prototyping of embedded systems IoT systems design				
Textbooks	1. J. W. Valvano, Embedded Systems: Introduction to Arm Cortex-M Microcontrollers, 2nd edition, Createspace, 2012.				
References	1. J. W. Valvano, Embedded Systems (Vol-2): Real-Time Interfacing to ARM Cortex-M Microcontrollers, 2nd edition, Createspace, 2011. 2. J. W. Valavano, Embedded Systems: Real-Time Operating Systems for Arm Cortex M Microcontrollers, CreateSpace, 2012. 3. McEwen and H. Cassimally, Designing the Internet of Things, Wiley, 2013.				

Course Title	Operations Research	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	2	0	2
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	To introduce students to use quantitative methods and techniques for effective decision-making; model formulation and applications that are used in solving business decision problems.				
Course Outcomes					
Contents of the course	Introduction to Operations Research: Introduction, Scope of Operations Research , Types, Operations Research Methodology, Role of operations research in decision-making. Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Simplex Method, The Simplex Algorithm, Penalty Cost Method or Big M-method, Two Phase Method, Graphical Methods to Solve Linear Programming Problems, Applications. Duality in Linear Programming Problem: Introduction, Importance of Duality Concepts, Formulation of Dual Problem, Economic Interpretation of Duality, Sensitivity Analysis Transportation Problem: Introduction, Formulation of Transportation Problem (TP), Transportation Algorithm (MODI Method), the Initial Basic Feasible Solution Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Routing Problem, Travelling Salesman Problem Integer Programming Problem: Introduction, Types of Integer Programming Problems, All IPP Algorithm, Branch and Bound Technique Project Scheduling and PERT-CPM: Introduction, Basic Difference between PERT and CPM, PERT/CPM Network Components and Precedence Relationship, Project Management – PERT Production Scheduling: Single machine, Flow Shop and Job Shop Scheduling.				
Textbooks	1. R. Paneerselvam, Operations Research, 2nd edition, Prentice Hall of India, 2009. 2. H. A. Taha, Operations Research: An Introduction, Pearson education, 2016.				
References	1. R. Ravindran, Operations Research and Management, CRC Press, 2008.				

Course Title	Internet of Things	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	To introduce the smart connected systems design using Internet of Things, Cloud storage and industrial automation.				
Course Outcomes	Students can able to design the smart connected systems and can apply the appropriate technologies and protocols in their design and automation.				
Contents of the course	The Internet of Things: An overview; Design Principles for Connected Devices; Internet Principles. (6) Thinking about Prototyping – Costs versus ease of prototyping, prototyping and Production, open source versus Closed Source. (4) Prototyping Embedded devices – Electronics, Embedded Computing Basics, Arduino/ Raspberry Pi/ BeagleBone Black/ etc., Electric Imp and other notable platforms (8) Prototyping of Physical Design. (6) Prototyping online Components – Getting Started with an API, Writing a New API, Real Time Reactions, Other Protocols. (6) Techniques for Writing Embedded Code – Memory Management, Performance and Battary Life, Libraries and debugging. (4) Automatic Storage Management in a Cloud World – Introduction to Cloud, Relational Databases in the Cloud, Automatic Storage Management in the Cloud. (6) Smart Connected System Design Case Study (2)				
Textbooks	1. A. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2013, ISBN-10: 111843062X. 2. N. Vengurlekar and P. Bagal, Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management, 1st edition, McGraw-Hill Education, 2013, ISBN-10: 0071790152.				
References	1. M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2010, ISBN-10: 0123748992. 2. F. Lamb, Industrial Automation: Hands on, 1st edition, McGraw-Hill Education, 2013, ISBN-10:0071816453.				

Course Title	Special Manufacturing Processes	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	To learn about various unconventional machining processes, process parameters and their influence on performance and their applications.				
Course Outcomes	1. Identify the necessity of "Special manufacturing Process" 2. Define with examples the concept of "Special manufacturing" 3. List the main classifications of the manufacturing processes with examples.				
Contents of the course	An Overview of unconventional machining, need, classification and selection. Process that make use of mechanical energy such as ultrasonic machining, water jet and abrasive jet machining methods with applications. (14) Electrochemical and Chemical Metal Removing Processes such as electrochemical machining, electrochemical honing, electrochemical grinding, and chemical machining. (15) Thermal Metal Removal Processes methods like plasma arc machining, neutral particle etching, electric discharge machining, hot machining, electron beam machining and laser beam machining. (15)				
Textbooks	1. P. C. Pandey and H. S. Shan, Modern Machining Processes, 1st edition, McGraw-Hill, 2013, ISBN: 9780070965539.				
References	1. F. Gary, Nontraditional Manufacturing Processes, 1st edition, CRC Press, 1987, ISBN: 9780824773526.				

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		
Prerequisite		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	Computer Aided Design and Manufacturing 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		
Prerequisite		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: 1. write part programs for milling, turning and wire-cut EDM 2. generate part programs for milling and turning using CAM software. 3. model free form surfaces and generate tool path for 5-axis machining. 4. 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	Internet of Things Practice	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	0	3	2
Offered for	B. Tech. MSM	Status (Core / Elective)	Core		
Prerequisite		To take effect from			
Course Objectives	To introduce the hands on implementation of smart connected systems design using Internet of Things, Cloud storage and industrial automation.				
Course Outcomes	Students can able to design the smart connected systems and can apply the appropriate technologies and protocols in their design and automation				
Contents of the course	Introduction to Microcontrollers and Sensors. I/O control interface programming. Communication protocol implementation and testing using Microcontroller. Configuring Wired/Wireless network interface to Microcontroller and programming Configuring cloud database management and accessing Sensors, Gateway and Cloud interface Data analysis from cloud and reporting				
Textbooks	1. A. Bagha and V. Madisetti, Cloud Computing: A Hands-on Approach, 1st edition, Universities press, 2015, ISBN-10: 8173719233. 2. B. Evans, Beginning Arduino Programming – Writing Code for the Most Popular Microcontroller Board in the World, 1st edition, Apress, 2011, ISBN-13: 9781430237778. 3. S. Chin and J. Weaver, Raspberry Pi with Java: Programming the Internet of Things (IoT), 1st edition, McGraw Hill Publisher, 2015, ISBN-10: 0071842012.				
References	1. M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2010, ISBN-10: 0123748992. 2. F. Lamb, Industrial Automation: Hands on, 1st edition, McGraw-Hill Education, 2013, ISBN-10:0071816453.				

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 1. Develop cross disciplinary idea 2. conceive, design and prototype an innovative idea 3. work in cross-functional groups and to apply the concepts learnt in theory to a practical problem 4. 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. C. Liu, Innovative Product Design Practice, Kindle Edition, ASIN: B00B29V9RQ 2. B. 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. C. Tong and D. Sriram, Artificial Intelligence in Engineering Design: Knowledge acquisition, commercial systems, and integrated environments, 1992, ISBN:9780080926025				