Curriculum and Syllabus for B.Tech.

Smart Manufacturing

(From The Academic Year 2020)

Approved in Senate 43 & 44

Indian Institute of Information Technology, Design and Manufacturing, Kancheepuram
Chennai-600 127

Semester 1								
S.No	Course Code	Course Name		Category	L	T	P	C
1	MA1000	Calculus		BSC	3	1	0	4
2	PH1000	Engineering Electromagnetics		BSC	3	0	0	3
3	EC1000	Electrical Circuits for Engineers		BEC	3	1	0	4
4	CS1000	Problem Solving and Programming		BEC	3	0	0	3
5	ME1000	Materials for Engineers		BEC	3	0	0	3
6	DS1000	Foundation for Engineering and Product Design		DSC	1	2	0	3
7	PH1001	Engineering Electromagnetics Practice		BSC	0	0	3	1.5
8	CS1001	Problem Solving and Programming Practice		BEC	0	0	3	1.5
9	HS1000	Effective Language and Communication Skills		HSC	1	0	2	2
10	NC1000	NSO Semester 1	Any one	NC	0	0	2	0
	NC1002	NCC Semester 1						
	NC1004	SSG Semester 1						
								25
Semester 2								
S.No	Course Code	Course Name		Category	L	T	P	C
1	MA1001	Differential Equations		BSC	3	1	0	4
2		Science Elective Course 1		SEC	3	1	0	4
3	ME1001	Engineering Graphics		BEC	2	0	4	4
4	CS1002	Elementary Data Structures and Logical Thinking		ITC	3	0	0	3
5	DS1001	Sociology of Design		DSC	1	2	0	3
6	ID1000	Design and Manufacturing Lab		ITC	0	0	2	1
7	ME1002	Applied Mechanics		PCC	3	0	0	3
8	CS1003	Elementary Data Structures and Logical Thinking Practice		ITC	0	0	4	2
9	ME1003	Applied Mechanics Practice		PCC	0	0	2	1
10	NC1001	NSO Semester 2	Any one	NC	0	0	2	0
	NC1003	NCC Semester 2						
	NC1005	SSG Semester 2						
11	NC1008	Earth, Environment and Design		NC	1	0	0	0
								25
Semester 3								
S.No	Course Code	Course Name		Category	L	T	P	C
1		Science Elective Course 2		SEC	3	1	0	4
2	DS2000	Systems Thinking for Design		DSC	1	2	0	3
3	ME2003	Manufacturing Processes - 1		PCC	3	1	0	4
4	ME2011	Theory of Machines and Design		PCC	3	0	0	3
5	EC2005	Electrical Drives		PCC	2	0	0	2
6	ME2012	Sensors and Controls		PCC	3	0	0	3
7	ME2004	Manufacturing Processes Practice - 1		PCC	0	0	3	1.5
8	CS2006	Introduction to Data Management		PCC	2	0	2	3
9	EC2006	Electrical Drives Practice		PCC	0	0	3	1.5
10	NC2000	Indian Constitution, Essence of Indian Traditional Knowledge		NC	1	0	0	0
								25

Semester 4							
S.No	Course Code	Course Name	Category	L	T	P	C
1		Science Elective Course 3	SEC	3	1	0	4
2	DS2001	Smart Product Design	DSC	1	2	0	3
3	ME2007	Manufacturing Processes - 2	PCC	3	1	0	4
4	ME2014	Thermal and Fluids Engineering	PCC	3	0	0	3
5	ME2015	Operations Research	PCC	3	0	0	3
6	ME2016	Production Drawing Practice	PCC	0	0	3	1.5
7	ME2010	Manufacturing Processes Practice - 2	PCC	0	0	3	1.5
8	EC2012	Embedded Systems Practice	PCC	1	0	2	2
9	CS2013	Machine to Machine Communication	PCC	2	0	2	3
10	NC2001	Human Values and Stress Management	NC	1	0	0	0
							25
Semester 5							
S.No	Course Code	Course Name	Category	L	T	P	C
1	CS3006	Introduction to Data Science for Engineers	ITC	3	0	2	4
2	DS3000	Entrepreneurship and Management Functions	DSC	1	2	0	3
3	ME3004	Operations and Supply Chain Management	PCC	3	0	0	3
4	ME3005	Robotics and Automation	PCC	3	0	0	3
5		Professional Elective Course 1	PEC	3	1	0	4
6	ME3006	Quality Engineering	PCC	2	0	2	3
7	ME3007	Robotics and Automation Practice	PCC	0	0	2	1
8	NC3000	Professional Ethics and Organizational Behaviour	NC	1	0	0	0
							21
Semester 6							
S.No	Course Code	Course Name	Category	L	T	P	C
1	DS3001	Prototyping and Testing	DSC	1	2	0	3
2		Professional Elective Course 2	PEC	3	1	0	4
3		Professional Elective Course 3	PEC	3	1	0	4
4		Free Elective Course 1	ELC	3	1	0	4
5		Free Elective Course 2	ELC	3	1	0	4
6	HS3000	Professional Communication	HSC	1	0	2	2
7	NC3001	Intellectual Property Rights	NC	1	0	0	0
							21
Semester 7							
S.No		Course Name	Category	L	T	P	C
1		Free Elective Course 3	ELC	3	1	0	4
2		Free Elective Course 4	ELC	3	1	0	4
3		Free Elective Course 5	ELC	3	1	0	4
4	ME4000	BT-SM-Summer Internship (May-Jul)	PCD	0	0	16	0
							12
Semester 8							
S.No	Course Code	Course Name	Category	L	T	P	C
1		Free Elective Course 6	ELC	3	1	0	4
2	ME4001	BT-SM-Project	PCD	0	0	16	8
							12

$ All NC courses are Pass/Fail courses for which the letter grade H/L shall be awarded.

Semester wise Credit Distribution

Category	Semester									
	S1	S2	S3	S4	S5	S6	S7	S8	Total	%
Basic Science Course (BSC)	8.5	4	0	0	0	0	0	0	12.5	7.5
Science Elective Course (SEC)	0	4	4	4	0	0	0	0	12	7.2
Basic Engineering Course (BEC)	11.5	4	0	0	0	0	0	0	15.5	9.3
Design Course (DSC)	3	3	3	3	3	3	0	0	18	10.8
IT Skill Course (ITC)	0	6	0	0	4	0	0	0	10	6.0
Professional Core Course (PCC)	0	4	18	18	10	0	0	0	50	30.1
Professional Elective Course (PEC)	0	0	0	0	4	8	0	0	12	7.2
Elective Course (ELC)	0	0	0	0	0	8	12	4	24	14.5
Humanities and Social Science Course (HSC)	2	0	0	0	0	2	0	0	4	2.4
Professional Career Development (PCD)	0	0	0	0	0	0	0	8	8	4.8
Total	25.0	25.0	25.0	25.0	21.0	21.0	12.0	12.0	166.0	100.0
	25.0	50.0	75.0	99.0	121.0	142.0	154.0	166.0		

Course Name	Calculus	Course Code	MA1000			
Offered by Department	SH -Mathematics	Structure (LTPC)	3	1	0	4
To be offered for	B.Tech	Course type	Core			
Pre-requisite	NIL	Approved In	Senate-43			
Learning 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, Lagrange multipliers – Optimization problems (7) • Multiple integrals – Evaluation of line and surface integrals (6)					
Essential Reading	•Thomas. G.B, and Finney R.L, Calculus, Pearson Education, 2007.					
Supplementary Reading	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 Name	Engineering Electromagnetics	Course Code	PH1000			
Offered by Department	SH -Physics	Structure(LTPC)	3	0	0	3
To be offered for	B. Tech	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate-43			
Learning Objectives	The objective of this course is to give an idea how the electromagnetic wave behaves. This alsoprovides an understanding of theories of electrostatics, magnetism and electrodynamics with theirapplications.Itwillenhance theproblemsolvingcapacityofthestudent.					
Contents of thecourse	• Vectors - an introduction;Unit vectors in spherical and cylindricalpolarco-ordinates;Conceptofvectorfields;Gradientofascalarfield; flux, divergence of a vector,Gauss's theorem,Continuityequation;Curl– rotationalandirrationalvectorfields,Stoke'stheorem. (12) • Electrostatics: • Electrostatic potential and field due to discrete and continuous charge distributions, boundarycondition, Energy for a charge distribution, Conductors and capacitors, Laplace's equationImageproblem, Dielectric polarization, electric displacement vector, dielectric susceptibility, energy indielectricsystems. (10) • Magneto statics: • Lorentz Force Law Bio-Savart's law and Ampere's law in magneto statics, Divergence and curl of B,Magnetic induction due to configurations ofcurrent-carryingconductors,Magnetization and boundcurrents,Energydensityinamagnetic fieldMagneticpermeability andsusceptibility. (10) • Electrodynamics: • Electromotiveforce,Time-varyingfields,Faradays'lawof electromagneticinduction, • Self and mutual inductance,displacement current, Maxwell's equations in free space. Boundarycondition, propagation in linear medium. Planeelectromagneticwaves—reflection andrefraction,electromagnetic energydensity,Pointing Vector.(10)					
Essential Reading	1.W.H.Hayt andJ.A.Buck,EngineeringElectromagnetics,TataMcGrawHillEducationPvt.Ltd, 2006.					
Supplementary Reading	1. W. H. Hayt, J. A.Buck and M.Jaleel Akhtar,Engineering Electromagnetics,McGraw Hill (India) Education Pvt. Ltd, Special Indian Edition 2020. 2. Purcell. E.M, Electricityand Magnetism BerkleyPhysics Course, V2, Tata McGraw Hill, 2008. 3. Feynman.R.P,Leighton.R.B,Sands.M,TheFeynmanLectureson Physics,Narosa Publishing House, Vol. II, 2008. Hill, 2008. 4. G.B.Arfken,H.J.WeberandF.E.Harris,MathematicalMethodsforPhysicists, Academic Press, 2013					

Course Name	ElectricalCircuitsforEngineers	Course Code	EC1000			
Offered by Department	ElectronicsandCommunication Engineering	Structure(LTPC)	3	1	0	4
To be offered for	BTECH	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate-43			
Learning Objectives	Thiscourseaimstoequipthestudentswithabasicunderstandingofelectricalcircuitsandmachinesforspecifictypesofapplications. Thiscoursealsoequipsstudentswithanabilitytounderstandbasicsofanalogganddigital electronics.					
LearningOutcomes	Thestudentsshalldevelopanintuitiveunderstandingofthecircuitanalysis,basicconceptsofelectricalmachines,andelectronicdevicesandcircuitsandbeabletoapplytheminproductdesignanddevelopment					
Contentsofthecourse *(Withapproximatebreak-upofhours)*	Elementsinelectricalcircuits:R,L,C,voltageandcurrentsources,Ohm'slaw,Kirchoff'sLaws**(4)** Networkanalysis:Nodalandmeshanalysiswithonlyindependentsources**(4)** Networktheorems:Superposition,Thevenin's&Norton's,Maximumpowertransfertheorems**(4)** DCcircuits:ResponseofRC,RLandRLCcircuits**(6)** ACcircuits:ACsignalmeasures,Phasoranalysisofsingle-phaseACcircuits,ThreephaseACcircuits**(6)** Machines:Transformers,DCgenerator,DCmotor,ACinductionmachines**(8)** Diodes:V-Icharacteristics,applications-rectifiers,clippers,clampers**(2)** Op-amps:gain,feedback,applications-inverting/non-invertingamplifiers,sumanddifferenceamplifier,comparators **(4)** Logicgatesandcombinationalcircuits–Basicgates,Karnaughmaps,Fulladder,halfadder **(4)**					
Essential Reading	EdwardHughes,IanMcKenzieSmith,JohnHiley,KeithBrown,'Hughe'sElectricalandElectronicTechnology',10th edition,Pearson,2010					
Supplementary Reading	1. CharlesAlexanderandMatthewSadiku'FundamentalsofElectricCircuits'7th Edition,McGrawHill,2021 2. C.H.Roth,Jr.,LarryRKinney,'FundamentalsofLogicDesign',7th Edition,CengageLearning,2013. 3. JacobMillman,ChristosCHalkais,SatyabrataJit,'Millman'sElectronicDevicesandCircuits',4th Edition,McGrawHillIndia,2015 4. StephenDUmans,'Fitzgerald&Kingsley'sElectricMachinery',McGraw-Hill,7thed.2020.					

Course Name	Problem Solving and Programming	Course Code	CS1000			
Offered by Department	Computer Science Engineering	Structure (LTPC)	3	0	0	3
To be offered for	B.Tech	Course type	Core			
Prerequisite	NIL	Approved In	Senate -44			
Learning Objectives	Focus is on problem solving using computers with C programming as the language. Data representation, base conversions, arithmetic in fixed and floating point representations, and problems related to this shall be covered. The sequence, selection and repetition statements in C programming language shall be discussed with case studies. The practice component of this course shall supplement theory by providing hands-on experience.					
Learning Outcomes	The teaching and assessment shall ensure that given a computational problem, students can use computers as a tool to model and solve the problem. Writing pseudo codes and C programming using basic programming constructs are expected out of the students. Students are expected to be conversant in number conversions and representations.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Computing Machine - Need and Applications - Evolution of Computing Machines (Calculators through Computers) Number Representation - Fixed and Floating Point - Base Conversions: Binary, Decimal, Octal, Hexa decimal number systems and conversions. (8 hours) • Basic programming constructs in C – Data types in C – Input and output statements – Formatted input/output - Control strings - return types - Case studies involving sequence statements (4hours) • Operators - Arithmetic, logical, relational, shift, unary operators - Precedence and Associativity (3 hours) • Selection Statements: IF-ELSE, SWITCH-CASE - Programs involving sequence and selection - GOTO statements - break statement - Nested IF - Switch inside if and vice-versa (5 hours) • Repetition Statements: FOR, WHILE - Programs involving sequence, selection and repetition - continue statement - Nested loops (5 hours) • Introduction to Arrays and Strings - Array manipulation - string manipulation - string operations - multi-dimensional arrays (6 hours) • Functions in C – Function declaration, definition – scope -storage Class-Built and user defined functions –Recursive functions (7 hours) • Introduction to Pointers, Dynamic Memory Allocation, Structures and File processing (7 hours)					
Essential Reading	Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 7th Edn, 2012.					
Supplementary Reading	Kernighan, Ritchie D, The C Programming Language, Prentice Hall, 2 Edn, 1988					

Course Name	Materials for Engineers	Course Code	ME1000			
Offered by Department	Mechanical Engineering	Structure (LTPC)	3	0	0	3
To be offered for	B. Tech	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate- 43			
Learning Objectives	• To provide overview of microstructure and properties of various engineering materials • To explore relations between performance of engineering products and microstructure, properties of materials that are used to construct them.					
Learning Outcomes	After the completion of the course, students will be able: • To explain the microstructure and properties of materials like steels, polymers, ceramics, and composites. • To understand the correlation of microstructure-properties-performance of materials so as to select suitable materials for engineering products.					
Contents of the course	• Classification and evolution of engineering materials, crystal structure, defects, crystallographic planes, directions, slip, deformation mechanical behavior, strengthening mechanisms, microstructure and properties of metal alloys (12) • Properties and processing of polymers, ceramics and composite materials, microstructure-property relationships (9) • Electrical, electronic and magnetic properties of materials, microstructure-property relationships (6) • Introduction to Nano, Bio, Smart and Functional materials. (3) • Introduction to selection of materials, Product based case studies on microstructure-property-performance of materials in the design of automobile; aircraft structures; e-vehicles; energy storage; electronic, optical and magnetic devices; and biomedical devices. (12)					
Essential Reading	1. William D. Callister Jr., David G. Rethwisch, "Materials Science and Engineering: An Introduction", 10th Edition, Wiley, 2018. 2. Michael Ashby, Hugh Shercliff, David Cebon, "Materials – Engineering, Science, Processing and Design", 4th Edition, Butterworth-Heinemann, 2018.					
Supplementary Reading	1. V Raghavan, "Materials Science and Engineering: A First Course, 5th Ed, 2007, PHI India. 2. Donald R. Askeland K Balani, "The Science and Engineering of Materials," 7th Edition, Cengage Learning, 2016. 3. Michael Ashby, "Materials Selection in Mechanical Design", 5th Edition, Butterwoth-Heinemann, 2016.					

Course Name	Foundation for Engineering and Product Design	Course Code	DS1000
Offered by Department	SIDI	Structure (LTPC)	1 2 0 3
To be offered for	B.Tech	Course Type	Core
Prerequisite	NIL	Approved In	Senate -43
Learning Objectives	The objective of this foundation program is to help students coming from +2 background to: • Unlearn limiting assumptions, risk avoidance, fear of failure • Awaken their senses & rediscover their creative selves • Experience the impact of design and technology in everyday objects		
Learning Outcomes	At the end the course, the student should ● demonstrate qualities of immersion in a task; ● unlearn key limiting assumptions; ● become comfortable with sketch-thinking and develop skills in design sketching; ● be excited by the potential of technology and design in improving lives;		
Contents of the course (With approximate break up of hours)	**Module-1: Induction: (5 hrs.)** • History of the place; the industrial ecosystem; institution • Exercises to improve interaction; local visits; **Module-2: Learn to observe nature and self (12 hrs)** ● Know your context - physical and social; ● Unlearning activities; Start journaling ● Observe wholes-parts (trees-leaves); variety of leaves; colors ● Document in a variety of ways - collage; sketch, paint, photograph, video **Module-3: Learn to observe everyday objects (15 hrs)** ● Unbundle everyday objects, observe, reorganize ● Whole-part relations; System physics; ● Observe interplay of art, design, culture, technology in everyday objects **Module-4: Visualize and Realize 3D objects (15 hrs)** ● Introduction to design sketching-1 (paper/pencil) ● Concepts of perspective drawing and product sketching. ● Introduction to color theory - mixing of colors to get different shades ● Explore variations on the form of chosen objects ● Realize designs with tools/materials (Origami; Clay; Foam cutting; Laser cutting; Glues) ● Introduction to digital sketching & 3D printing Evaluation: Continuous assessment (80%); Final Form Designs Presentation (20%)		
Essential&Supplementary Reading	1. Kevin Henry, Drawing for Product Designers, Laurence King Publishing, 2012, ISBN:9781856697439 2. KoosEissen and RoselienSteur, Sketching – The Basics, BIS Publishers, 2011, ISBN:9789063695347 3. Thomas C Wang, Pencil Sketching, John Wiley, 2002, ISBN:9780471218050 4. Wucius Wong, Principles of Color Design: Designing with Electronic Color, John Wiley, 2nd Edition, 1996, ISBN:9780471287087		

Course Name	EngineeringElectromagneticsPractice	Course Code	PH1001			
Offered by Department	SH-Physics	Structure(LTPC)	0	0	3	1.5
To be offered for	B.Tech	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate-43			
Learning Objectives	The objective of this course is to give a hand on experience how the electromagnetic wave behavesin different situations. The students will be able to relate the knowledge they have got in the theoryclass with their experience. This course will enhance their skill of handling instruments and thepresentationof the results obtainedfromtheexperiments.					
Contents of thecourse	Electricalandmagneticpropertiesofmaterialsbasedontheconceptofelectricalpolarization,magnetizationofmaterialswillbe studiedin variousexperiments. Experimentsbasedonthe conceptof phenomenasuchasinterference,diffractionetc.relatedtoelectromagneticwaveswillbedoneherean dthesemethodswillbeappliedtomeasuresomeunknown physical quantities such as wavelength of a light, diameter of a very thin wire, very smallaperture forlightetc.					
Essential Reading	1.IIITD&MLaboratorymanualforElectromagneticWavePractice					
Supplementary Reading	1.W.H.Hayt andJ. A.Buck,EngineeringElectromagnetics,TataMcFrawHill EducationPvt. Ltd,2006.					

<table>
<tr><td>Course Name</td><td>Problem Solving and Programming Practice</td><td>Course Code</td><td colspan="4">CS1001</td></tr>
<tr><td>Offered by Department</td><td>Computer Science Engineering</td><td>Structure (LTPC)</td><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>To be offered for</td><td>B.Tech</td><td>Course Type</td><td colspan="4">Core</td></tr>
<tr><td>Prerequisite</td><td>NIL</td><td>Approved In</td><td colspan="4">Senate-43</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">Focus is on problem solving using computers with C programming as the language. The sequence, selection and repetition statements in C programming language shall be discussed with case studies.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">The teaching and assessment shall ensure that given a computational problem, students can use computers as a tool to model and solve the problem. Writing pseudo codes and C programming using basic programming constructs are expected out of the students. Students are expected to be conversant in number conversions and representations.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Introduction to text editors - basic text processing - case studies involving office software - doc and ppt creation
Introduction to Linux commands - file/directory creation - copy, move, pdf creation, zip commands
Case studies using sequence statements - input/output statements - arithmetic with precedence and associativity.
Case studies involving selection and repetition statements - functions – recursion</td></tr>
<tr><td>Essential Reading</td><td colspan="6">Deitel P J and Deitel H M, C : How To Program, Prentice Hall, 7th Edn, 2012.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">Kernighan, Ritchie D, The C Programming Language, Prentice Hall, 2 Edn., 1988</td></tr>
</table>

Course Name	Effective Language and Communication Skills	Course Code	HS1000			
Offered by Department	SH- English	Structure(LTPC)	1	0	2	2
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-43			
Learning Objectives	• Hone LSRW and practice critical thinking • Enable students to speak and write grammatically acceptable sentences • Train students in technical communication • Cultivate interest to learn language and to build the confidence to communicate in English • Develop an interest in updating their language skills through continuous learning • Connecting personal growth with improvement in their proficiency in English					
Learning Outcomes	• Able to communicate effectively with grammatically acceptable constructions and appropriate wordsin formal and informal situations • Can extract information effectively and able to think critically • Able to present technical content confidently					
Course Contents(with approximatebreakup of hours forlecture/ tutorial/ be donepractice)	• Introduction: Language, effective communication, ethics and aesthetics of communication (L1) • Phonetics – sounds, pronunciation of words, stress, intonation, listening, Varieties of English (L3, P4) • Sentence structure, concord, punctuation, stylistic errors, common errors (L3, P4) • Reading and comprehension (L2, P5) ➢ Different types of reading, analyzing the organization of the text ➢ Critical thinking- thesis statement, argument, hypothesis, order, reason, evidence, consistency,tautology, conclusion • Exercises for vocabulary enrichment (for daily practice) • Speaking (L2, P5) ➢ Barriers to effective communication, technical presentation and presentation skills, self-introduction, ➢ Requests, enquiry, suggestion in formal and informal situations, reporting an event, grouppresentation – debate • Writing (L3, P8) ➢ Writing formal letters, email, résumé, ➢ Data interpretation, reports, product description/requirements/ technical instructions, recordingobservations ➢ The language of content strategy - voice and tone strategy - the language of localization – textanalysis tools ➢ Plagiarism – the importance of documentation, different methods of note-taking ➢ Essays/story/ book & movie reviews/writing for social media/blogging/ journaling • Life lessons through stories and activities (P2)					
Essential &Supplementary Reading	1. Tebeaux, Elizabeth, and Sam Dragga. *The Essentials of Technical Communication*. OUP, 2018. 2. Rizvi, M Ashraf. *Effective Technical Communication*. McGraw-Hill, 2017 3. Hancock, Mark. *English Pronunciation in Use: Intermediate Self-study and Classroom Use.*CUP,2012. 4. Cottrell, Stella. *Critical Thinking Skills: Developing Effective Argument and Analysis*. Palgrave,2005. 5. Gower, Roger. *Grammar in Practice*. CUP, 2005. 6. Paterson, Ken. *Oxford Living Grammar*. OUP, 2014. 7. Sabin, William A. *The Gregg Reference Manual:A Manual of Style, Grammar, Usage, andFormatting*. McGraw-Hill, 2011. 8. Fitikides, T. J. *Common Mistakes in English*. London: Orient Longman, 1984.					

	Leech, Geoffrey and Jan Svartvik. A Communicative Grammar of English. Routledge, 2013. 9. Astley, Peter and Lewis Lansford. *Oxford English for Careers: Engineering*. OUP, 2013. 10. Savage, Alice and Patricia Mayer. *Effective Academic Writing*. OUP, 2013 11. Harari, Yuval Noah. *Sapiens: A Brief History of Humankind*. Vintage, 2014. 12. https://www.ted.com/ 13. https://www.bbc.co.uk/learningenglish/features/pronunciation/tims-pronunciation-workshop-ep-13 14. https://learnenglish.britishcouncil.org/skills/listening 15. https://www.nationalgeographic.com/podcasts/overheard 16. https://www.youtube.com/user/NatureVideoChannel 17. https://www.youtube.com/watch?v=Aj-EnsvU5Q0&list=PLcetZ6gSk969oGvAI0e4_PgVnlGbm64bp 18. https://www.merriam-webster.com/word-of-the-day 19.https://www.newyorker.com/tag/book-reviews

Course Name	Differential Equations	Course Code	MA1001			
Offered by Department	SH-Mathematics	Structure (LTPC)	3	1	0	3
To be offered for	B.Tech	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate-44			
Learning 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)					
Essential Readings	1. Simmons. G.F, Differential Equations, Tata McGraw Hill, 2003. 2. Kreyszig. E, Advanced Engineering Mathematics, Wiley, 2007.					
Supplementary Reading	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 Name	EngineeringGraphics	Course Code	ME1001			
Offered by Department	MechanicalEngineering	Structure(LTPC)	2	0	4	4
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
LearningObjectives	• Tointroducethebasicconceptsandtechniquesoftechnicaldrawing. • 2D and 3D representation of various shapes/objects and its engineeringapplications.					
LearningOutcomes	Students will acquire visualization skills and will be able to prepare technicaldrawingsand 3Dmodels usingcomputer aidedtools.					
Course Contents(with approximatebreak up of hours forlecture/tutorial/ practice)	• Roleoftechnicaldrawinginproductdevelopmentprocess,Basicsoftechnicaldrawing,Standards, Dimensioningprinciples.*(L2+P4hrs.)* • Computeraideddrafting.*(L2+P8hrs.)* • Engineeringcurvesanditsapplications. *(L4+P8hrs.)* • Principles of orthographic projection. Orthographic projection of points, lines,planes and regular solids, Exercises related to engineering applications. *(L7+P8hrs.)* • Principlesofisometricprojections.Orthographictoisometricandisometrictoorthographictransformation ofobjects.*(L3+P8hrs.)* • Sectionandintersectionofregularsolidsandtheirlateraldevelopments. • *(L6+P12hrs.)* • Introduction to 3D modelling of shapes and objects; electrical CAD. *(L2+P4hrs.)*					
Essential Reading	1. K.Venugopal andVPrabhuRaja,EngineeringDrawing+AutoCAD,NewAgeInternational (P)Limited.5th EditionReprint:July, 2016 2. Narayana.K.L,andKannaiah.P,EngineeringDrawing,ScitechPub.Pvt.Ltd, 3. 3rdEdition.					
Supplementa ryReading	1. PIVarghese,EngineeringGraphics,McGrawHillEducation,2013. 2. Bhatt.N.D,EngineeringDrawing–PlaneandSolidGeometry,CharotarPublishingHouse Pvt. Ltd.,53 Edition 2014.					

CourseName	ElementaryDataStructures andLogicalThinking	CourseCode	CS1002			
Offered by Department	Computer Science Engineering	Structure(LTPC)	3	0	0	3
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
LearningObjectives	Thefocusisto discuss howdataisorganizedandretrievedin computers.Elementarydatastructureswithsupportingoperationsshallbediscussed.Studentswillbeexposed toart of logical thinkingthroughalgorithmicpuzzles.					
LearningOutcomes	At the end of the course, given a computational problem, students are expected tocomeupwithanalgorithmandasuitabledatastructure,andimplement thesame usingaprogramminglanguage.					
Course Contents(with approximatebreakup of hours forlecture/tutorial/practice)	• HistoryofComputingandComputers–theneedfordataorganization–introductionto abstract data types anddata structures(3L) • Introduction to logical thinking (algorithmic thinking) through simple examples.Introduction to Elementary data structures - Discussion on Stacks and Queueswithsupportingoperations–implementationusingarraysandlists–implementation of stack using queues and vice-versa – variants of stacks andqueues– algorithmic puzzles (10L) • Arraysandapplications-algorithmicpuzzlesinvolvingarrays-sortingandsearching.(8L) • Discussiononlinkedlistswithvarioussupportingoperations-algorithmicpuzzles involving lists.Types of Lists – double, circular – the need for doubleandcircular linked lists–puzzles involvinglists (10L) • Introductionto trees,binarytrees,searchtrees (7L) • Applications of elementary data structures in computer science and engineering.(7L)					
Essential Reading	1. M. A. Weiss,DataStructuresand Algorithm AnalysisinC, 2nded.,Pearson,2002. 2. AnanyLevitinandMariaLevitin,AlgorithmicPuzzles,OxfordUniversityPress,2011.					
Supplementary Reading	1.NarasimhaKarumanchi,DataStructureandAlgorithmicThinkingwithPython,CareermonkPublications, 2017					

Course Name	SociologyofDesign	Course Code	DS1001			
Offered by Department	SIDI	Structure (LTPC)	1	2	0	3
To be offered for	B.Tech	Course Type	Core			
Prerequisite	FoundationProgram	Approved In	Senate 43			
Learning objectives	The objective of the course is to introduce engineering students tothe importance of understanding the social context of technologyandproductdesign: • Observing the problem context and surfacing unstateduser/customerneeds/newproductconcepts, • Understanding people, team dynamics and working in multicultural /cross-functional/distributed teams.					
CourseOutcomes	Attheend ofthecourse,thestudentsshould beinaposition to: • Understandtheneedandtheprocessofdoinganethnographicstudy • Surfaceunstatedneeds andarticulate thehighlevel productrequirements • Connectwith people,formteams andcollaborate towardsacommongoal					
Contents of the course(With approx. mate breakupofhours)	Module1:Technology,DesignandSociety-[9hrs] ● Observethewaypeopleinteract withobjects ● Understandingthe relationship betweenpeopleandavarietyofobjects ● ActorNetworkTheory;HistoryofTechnologyandDesign;2-3Casestudies ● Discoveryourpassionanddomainofinterest&networktoidentifypartners Module2:Understandinguser/customercontexts[21hrs] ● Ethnography-immersioninaproblemcontext ● Learningtoobserve-seeandlisten; ● Developingrichpictures;Gigamapping ● Introductiontosignsandsemioticanalysis Module3:Understandinggroups(multicultural/cross-functionalteams)[12hrs] ● Learningteamformationanddynamicsthroughamovie; ● Introduction to sociological imagination - Functionalism, ConflictTheory,SymbolicInteractionism;InteractionRitualChains ● Values,culture, methodsofengineersanddesignersandhowtheyshapethequalityof our lives; ● Groupdynamicswithinorganizationsandacrossorganizationsandim plications for innovationandchange Evaluation:Continuousassessment(40%);Finalethnographyreport(20%);End Semester(40%)					
Essential & Supplementary Readings	1. TrevorPinch(Editors)(2012),TheSocialConstructionofTechnologicalSyste ms:Newdirections inthesociologyandhistoryoftechnology, MITPress,AnniversaryEdition 2. WendyGunn,TonOttoandRachelSmith(2013),DesignAnth ropology:Theoryand practice,Bloomsbury 3. AdrianForty(2014),Objectsofdesire:Designand societysince1750s,Thames&Hudson 4. BernhardEBurdek(2015),History,theoryandpracticeofproductdesign,seco nd revisededition 5. KeriSmith(2008),Howto beanExplorer oftheWorld:PortableLifeMuseum,PenguinGroup					

Course Name	DesignandManufacturingLab.	Course Code	ID1000			
Offered by Department	SIDI	Structure(LTPC)	0	0	2	1
To be offered for	B. Tech	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate-44			
Learning Objectives	The objective of this course is to give an exposure on the basic practices followed in thedomainofmechanical,electrical,electronicsandcommunicationengineering.Theexercises will train the students to acquire skills which are very essential for the engineersthroughhands-on sessions.					
Contents of thecourse	Experimentswillbeframedtotrainthestudentsinfollowingcommonengineeringpractices: Basic manufacturing processes: Fitting, Drilling & tapping, Material joining processes,Carpentry, Sheet-metal work, Adhesive bonding and plastic welding, Arc Welding, 3DPrinting.(10 hours) Familiarizationofelectroniccomponentsby Nomenclature,meters,powersupplies,function generators and Oscilloscope – Bread board assembling of simple circuits: IRtransmitterand receiver –LEDemergencylamp–Communicationstudy:amplitudemodulationanddemodulation.(6 hours) Domestic wiring practice: Fluorescent lamp connection, Staircase wiring – Estimation andcosting of domestic and industrial wiring – power consumption by Incandescent, CFL andLEDlamps. (2 Hours) Dismantleand assemblyofPC.InstallingOS anddiskmanagement.(4 hours)					
Essential Reading	1. UppalS.L.,"ElectricalWiring&Estimating", 5Edn,KhannaPublishers,2003. 2. Chapman.W.A.J., WorkshopTechnology, Part1&2, Taylor &Francis.					
Supplementary Reading	1. ClydeF.Coombs,"Printed circuitshand book",6Edn,McGraw Hill,2007. 2. John H. Watt, Terrell Croft, "American Electricians' Handbook: A ReferenceBookforthe PracticalElectricalMan",Tata McGrawHill,2002.					

CourseName	Applied Mechanics	CourseCode	ME1002			
Offered by Department	MechanicalEngineering	Structure(LTPC)	3	0	0	3
To be offered for	B.Tech	Course Type	Core			
Prerequisite	MaterialsforEngineers	Approved In	Senate -44			
LearningObjectives	Thiscourseisintendedto give an understandingof ● theforceandmomentsystems onmechanicalstructures ● the equationsgoverningrigid bodysystems ● the behaviorofsolidbodiessubjected to varioustypes ofloads. ● theconnectionbetweenthepropertiesofmaterialsandthe behaviorofphysicalsystems.					
LearningOutcomes	Atthecompletionofthecourse,thestudentwillbeable to ● analyze theinteractions ofvariousstructuralelements ● applytheprinciplesto practicalstructuralanalysis ● carryoutdesign andfailureanalyses ofbasicmechanicalstructures.					
CourseContents(with approximatebreakup ofhoursforlecture/tutorial/practice)	• Engineeringmechanics: • Equivalentforcesystems,freebodyconcepts,equationsofequilibrium;Trusses (L12) • Strengthofmaterials: • stress,strainandtheirrelationforsimpletension,compressionandshear;Axialload;Torsion (L9) • Bending– Shearforceand Bendingmoment,Stresses,Deflection;Euler'stheoryofcolumns (L9) • Analysis ofstress and strain– Transformations,Principalstresses andstrains,Planestress,Mohr'scircle;Thincylinders;Theoriesoffailure. (L12)					
EssentialReading	1. B.J.GoodnoandJ.M.Gere,Statics and Mechanicsof Materials,CLEngineering,SIedition, 2018.ISBN-13:978-133364412.					
Supplementary Reading	1. F.P.Beer,E.R.Johnston,J.T.Dewolf,andD.F.Mazurek,StaticsandMechanicsofMaterials,McGrawHill,3rdedition,2021,ISBN-13:978-0073398167. 2. R.C.Hibbeler,StaticsandMechanicsofMaterials,5thedition,Pearsoneducation,2016,ISBN-13:978-0134382593. 3. W.F.Riley,L.D.SturgesandD.H.Morris,StaticsandMechanicsofMaterials:An integratedapproach,Willey,2ndedition, 2018,ISBN-13:978-0471013341. 4. A.Bedford,K.LiechtiandW.Fowler,StaticsandMechanicsofMaterials,5thedition,Pearsoneducation,2002, ISBN-13:978-0130285935.					

Course Name	Elementary Data Structures And Logical Thinking Practice	Course Code	CS1003			
Offered by Department	Computer Science Engineering	Structure(LTPC)	0	0	4	2
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
LearningObjectives	• Thefocusistodiscuss howdataisorganizedandretrievedin computers. • Elementarydatastructureswithsupportingoperationsshallbediscussed.Studentswillbe exposed toart of logical thinkingthroughalgorithmicpuzzles.					
LearningOutcomes	Attheendofthecourse,givenacomputationalproblem,studentsareexpectedto comeupwithanalgorithmandasuitabledatastructure,andimplement thesameusinga programminglanguage.					
Course Contents(with approximatebreakup of hours forlecture/tutorial/practice)	• Case studies that motivates logical thinking (algorithmic thinking) – implementationusingCprogramming • Case studies involving arrays and implementation - Arrayswith varioussupporting operations- algorithmic puzzles involving arrays – sorting andsearching • Examples on linked listswith various supporting operations- algorithmicpuzzlesinvolvingsingly,doublyandcircularlinkedlists.– puzzlesinvolvinglists • Case studies on Stacks and Queues with supporting operations – implementationusing arrays and lists – implementation of stack using queues and vice-versa –variantsof stacks andqueues– algorithmic puzzles • Applications of elementary data structures in computer science and engineeringandimplementation					
Essential Reading	1. M. A. Weiss,DataStructuresand Algorithm AnalysisinC, 2nded.,Pearson,2002. 2. AnanyLevitinandMariaLevitin,AlgorithmicPuzzles,OxfordUniversityPress,2011					
Supplementary Reading	1. NarasimhaKarumanchi,DataStructureand AlgorithmicThinkingwithPython,CareermonkPublications, 2017					

CourseName	AppliedMechanicsPractice	Course Code	ME1003			
Offered by Department	MechanicalEngineering	Structure(LTPC)	0	0	2	1
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	MaterialsforEngineers	Approved In	Senate-44			
LearningObjectives	Thiscourseisintendedto give a hands-onexperienceto ● relatetheoreticalprinciplesofrigidbodymechanicstovariouspracticalsystems ● findthepropertiesofmaterials byapplyingvariousexperimentalmethods. ● applytheequationsandseetherealtimebehaviorofdeformablebodiesandvariousstructuralelements ● handletheinstrumentsandpresenttheresults					
LearningOutcomes	Atthecompletionofthecourse,thestudentwillbeable to ● analyze theinteractions ofvariousstructuralelementsexperimentally ● do mechanicalcharacterizationofthematerials ● applystandardmethodsoftestingmaterials.					
CourseContents(with approximatebreakup ofhoursforlecture/tutorial/practice)	Experimentstoinvestigatethevariationofstaticcoefficientoffrictionwithvariouscombinations ofmaterialsurfacesandradiusofgyrationwithbarandtorsionalpendulums. (P9) Experimentstomeasurevariousmaterialpropertiessuchasrigiditymodulus,Young'smodulus ,flexuralmodulus,Poisson'sratio,etc. (P12) Experimentstostudytheinfluenceofmicrostructureon Young'smodulus,hardness,tensilestrength,creep,etc. (P6) Experimentstostudytheinfluenceofgeometryandthestrengthofmaterialsonstructuralelements likebeamand column. (P6)					
EssentialReading	1. B.J.GoodnoandJ. M.Gere,StaticsandMechanicsofMaterials,CLEngineering,SIedition, 2018.ISBN-13:978-133364412.					
Supplementary Reading	1. F.P.Beer,E.R.Johnston,J.T.Dewolf,andD.F.Mazurek,StaticsandMechanicsofMaterials ,McGrawHill,3rdedition,2021,ISBN-13:978-0073398167. 2. R.C.Hibbeler,StaticsandMechanicsofMaterials,5thedition,Pearsoneducation,2016,ISBN-13:978-0134382593. 3. W.F.Riley,L.D.SturgesandD.H.Morris,StaticsandMechanicsofMaterials:An integratedapproach,Willey,2ndedition, 2018,ISBN-13:978-0471013341. 4. A.Bedford,K.LiechtiandW.Fowler,StaticsandMechanicsofMaterials,5thedition,Pearsoneducation,2002, ISBN-13:978-0130285935.					

Course Name	Earth, Environment and Design	Course Code	NC1008			
Offered by Department	SIDI	Structure (LTPC)	1	0	0	P/F
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning 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.					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Introduction to environment and ecology – Ecosystems Impacts of natural and human activities on ecosystems • Environmental policies, acts and standards, Environmental Impact Assessment Prediction and assessment of the impacts on air, water, land, and biological environments Assessment of impacts of the cultural, socioeconomic and eco sensitive environments					
Essential Reading	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.					
Supplementary Reading	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 Name	SystemsThinkingforDesign	Course Code	DS2000			
Offered by Department	SIDI	Structure(LTPC)	1	2	0	3
To be offered for	B.Tech	Course Type	Core			
Pre-requisite	Sociology of Design	Approved In	Senate-43			
Learning Objectives	Designforeffectiveness –Level 1					
Learning Outcomes	Thiscoursewillhelpstudentsunderstand •Theimportanceofmodelingsystemstorealizeeffectivedesigns •Abstractionof keyelements fromproblemsituations • Useofspecifictechniquestomodel problemsinaholisticmanner					
Contents of thecourse	•Real-worldproblems&theneedforinter-disciplinaryapproaches [2] •Basicconceptsofsystemsthinking(parts,relations,patterns)[6] •Technique#1:RichPictures •Technique#2:MappingStakeholder,Needs,Alterables,Constraints[6] •Technique#3:StructuralModeling(Hierarchicaldecomposition)[6] Technique#4:InfluenceDiagrams(Self-regulatingsystems)[6]					
Essential Reading	1. Hitchins,DerekK. (2007) SystemsEngineering:A21stCenturySystemsMethodology,JohnWiley,ISBN:978-0-470-05856-5. 2. Wilson,Brian(1991)Systems:Concepts,MethodologiesandApplications.2ndEdition,Wiley.ISBN:0471927163. Hutchinson,William;SystemsThinkingandAssociatedMethodologies,PraxisEducation.ISBN:0 646 34145 6.					
Supplementary Reading	1. GeraldWienberg(2001),Anintroductiontogeneralsystemsthinking,DorsetHousePublishing. 2. Sage,A.P.(1977);MethodologyforLargeScaleSystems,McGrawHill,New York.					

CourseName	TheoryofMachinesandDesign	Course Code	ME2011			
Offered by Department	MechanicalEngineering	Structure(LTPC)	3	0	0	3
To be offered for	B.Tech	Course Type	Core			
Prerequisite	AppliedMechanics	Approved In	Senate-44			
LearningObjectives	• Tounderstandthekinematicsandkineticsofvariousplanarmechanisms. • Tounderstanddesignconceptsandproceduresnecessarytodesignand/orselectamachinecomponentintermsofgeometryandmaterials.					
LearningOutcomes	Attheendofthecourse,astudentwillbeableto: • Investigatethemotionofplanarmechanismsusinggraphicalandanalyticmethods. • Applymultidimensionalfailurecriteriaintheanalysisanddesignofmachinecomponents. • Designofpowertransmissionsystemsinvolvingshafts,gears,beltsandbearings.					
CourseContents	•Introductiontomechanisms-joints,pairsandcouplings;Constraints,mobilityanddegreeoffreedom,mobilitycriterion,Grashof'slaw.(6L) •AnalysisofPlanarMechanism(Position,VelocityandAcceleration);CamsandFollowers.(8L) •DesignbasedonFailuretheories;DesignofShafts,KeysandCouplings.(8L)DesignofJoints-Bolted,RivetedandWeldedJoints(8L) •DesignofSpurGearsandBeltDrives (6L) • DesignofClutchesandBearings(6L)					
EssentialReading	1. J.J.Uicker,G.R.PennockandJ.E.Shigley,TheoryofMachinesandMechanisms,OxfordUniversityPress,4thEdition,2014. 2. R.G.BudynasandJ.K.Nisbett,Shigley'sMechanicalEngineeringDesign, McGraw-HillEducation,10thEdition,2017					
Supplementary Reading	1. GhoshandA.K.Mallik,TheoryofMechanismandMachines,AffiliatedEast –WestPressPrivateLtd.,2009. 2. Norton,R.L.,DesignofMachinery,ThirdEdition,TataMcGrawHill,NewDelhi,2005. 3. VBhandari,DesignofMachineElements,McGraw-HillEducation,4thEdition,2017. 4. RobertL.Norton,MachineDesign,PearsonEducation,5thEdition,2018					

Course Name	ManufacturingProcesses-1	Course Code	ME2003			
Offered by Department	MechanicalEngineering	Structure(LTPC)	3	1	0	4
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	Materials for Engineers	Approved In	Senate-44			
LearningObjectives	Tostudythefundamentalsofmanufacturingprocessesand equipment.					
LearningOutcomes	● Attheend,thestudentswillbeabletoselecttherangeofmanufacturingprocessessuitabletore alizetheintendedphysicalcomponents/products. ● Attheendthestudentswillbeabletoidentifythecausesofthedefectsifanyfoundinthecompon ents/productsmanufacturedandrectifyusingsuitablecombinationsofparameters.					
CourseContents(withapproxi matebreakup ofhoursforlecture/tutorial/prac tice)	**Moldingand CastingPractices:**(16*L*+ 5 *T)* Introductiontocastingandfoundryindustry;basicprinciple;sequenceinfoundryoperations; patterns;moldingpractice;ingredientsofmoldingsandandcores.Meltingfurnaces.Specialc astingtechniques:investmentcasting,shellmolding,diecasting,centrifugalcasting,plaster mouldcasting,magneticcasting,squeezecasting,fullmouldprocess,stripcasting,CO_2moldi ng.Gatingsystemdesign.Castingdefectsandfoundryautomation. **FormingandForging:**(14*L*+ 5 *T*) Basicsofplasticforming&forging,forgingprocess–classification–equipment – calculationofforgingloads–forgingdefects–residualstresses,rollingandextrusion– classification-rollingmills-rollingofbars&shapes–rollingforces – defectsinrolling-theoriesofhot&coldrolling– torquepowerestimation.Extrusion:classification-equipment– deformationlubricationanddefects–analysis–hydrostaticextrusion– tubeextrusion.Drawing&sheetmetalforming-rod &wiredrawing,deepdrawing,tubedrawing,shearingand blanking. **Weldingprocesses:**(12*L*+ 4 *T*) Classificationofweldingprocesses,V-Irelationship,typesofweldjoints. Fusion weldingprocesses,solidstateweldingprocesses,thermo-chemicalweldingprocesses,brazingandsoldering.WeldMetallurgy;conceptofHAZ,defectsin welds,theircausesand remedies.					
EssentialReading	1. S.Kalpakjian,S.R.Schmidt,ManufacturingEngineeringandTechnology,7th edition,Pea rsonIndia,2009.ISBN:978-0133128741 2. M.P.Groover,PrinciplesofModernManufacturing,5th edition,Wiley,2014.978-8126547371.					
SupplementaryReading	1. B.Wulff,H.F.TaylorandM.C.Fleming,FoundryEngineering,WileyEastern,2009. 2. AmericanWeldingSociety,WeldingHandbook,AWS,2009. 3. G. E Dieter,MechanicalMetallurgy, TataMcGraw Hill,2007.					

CourseName	Electrical Drives	Course Code	EC2055			
Offered by Department	Electronics &Communication Engineering	Structure(LTPC)	2	0	0	2
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	Basic Electrical Engineering	Approved In	Senate-44			
LearningObjectives	● 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					
LearningOutcomes	At the end of the course, a student will be able to, ● Understand how power electronic rectifiers, converters and inverters operate. ● Possess an understanding of control of electrical drives. ● Analyze and compare the performance of DC and AC machines. ● Select and design a suitable drive system for the given application.					
CourseContents	Energy conversion principles, Introduction to Electrical Drives, controlled Rectifiers, DC/DC converters, inverters (L6) Characteristics and control (starting, braking and speed control-static methods only) of Basic machine types: DC motor (L8) Three phase Induction motor (L8) BLDC motor (L3) Servo motor, torque motor, stepper motor (L3)					
EssentialReading	3. Gopal K. Dubey, Fundamentals of Electrical Drives, 2nd edition, Narosa, January 2010, ISBN-13: 978-8173194283 4. Ned Mohan, Electric Machines and Drives: A First Course, 1st edition, Wiley, 2012.					
Supplementary Reading	5. VedamSubramanyam, Electric Drives, McGraw Hill, 2017, ISBN-13: 978-0070701991 6. D.P. Kothari, Rakesh Singh Lodhi, Electric Drives, TMH, June 2020 7. I. Boldea, S. A. Nasar, Electric drives, 3rd edition, CRC Press, 2017.					

CourseName	Sensorsand Controls	Course Code	ME2012			
Offered by Department	Electronics & Communication Engineering	Structure(LTPC)	3	0	0	3
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	ElectricCircuitsandMathematics	Approved In	Senate-44			
LearningObjectives	The objectiveofthiscourse is • to learn the basicworkingprinciple and operationofvarioussensors and itscharacteristics • to leveragetheapplicationofseniorsinengineeringapplication(c)to learntheconceptsofcontrolsystems.					
LearningOutcomes	Attheendofthecourse,astudentwillbeable • toleveragesensorsforvariousengineeringapplicationsandchoosesensorsforrequiredspecification • tounderstandcontrolsystems and itsrelevancedifferentapplications					
CourseContents	Introduction:Descriptionofmeasuringdevices-staticanddynamiccharacteristics,calibration,active and passivesensors, transducers,classifications. (L6) DisplacementSensors-Resistivestraingauge,LVDT,RVDT,capacitive,piezo,seismicpickups.proximity,vibrometers andaccelerometers-conventionalandsemiconductorbasedsensors. (L8) Sensorsforflow,temperature,force,pressure,Radiationandtorque,Halleffect-Currentandspeedmeasurements-conventionalandsemiconductorbasedsensors-Digitalmeasurementtechniques. (L8) OpticalSensor:Lasers.photo-detectorsandopticalfiberassensors,ApplicationofsensorsinRobotics-InternalSensors,Externalsensors–touchandslipsensors-Roboticvision,ProcessofImaging, VisionSystems,anditscomponents,ImageRepresentationa nd Processing. (L8) Chemical,magneticandothersignals,Catalyticdevices,gassensorsandacousticsensors. (L4) Openandclosedloopsystems,actuators-electrical pneumaticandhydraulic Transferfunctions-rootlocusmethod Design					
EssentialReading	1. J.VetelinoandA.Reghu,Introductiontosensors,CRC Press,2010 2. Norman SNise, ControlSystem, John Wiley, 7th Edition, 2015 3. A.K.Sawhney,ACourseinElectronicMeasurementsandInstrumentation,DhanpatRai, 2015					
Supplementary Reading	1. T. G.Beckwith,R.D.MarangoniandJ. H.LienhardV., MechanicalMeasurements,PearsonPrenticeHall,2009. 2. J.Fraden,HandbookofModernSensors:Physics,DesignsandApplications,4thedition,Springer,2010 3. Doebelin,Measurementsystems:ApplicationsandDesign,5thedition,McGrawHillBook , 2004.					

CourseName	ManufacturingProcessesPractice-1	CourseCode	ME2004			
Offered by Department	MechanicalEngineering	Structure (LTPC)	0	0	3	1.5
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	Basics ofManufacturingProcesses	Approved In	Senate-44			
LearningObjectives	Toperformexperimentsonfundamentalmanufacturingprocessestounderstandthe process,equipment, toolingandset-upinvolved intheseprocesses.					
LearningOutcomes	• Attheend,studentswillbeabletoapply: • Asuitablecastingprocesstoshapethecomponentand identifythedefectsinvolved and rectifythem. • Selectsuitableweldingprocessesbasedon theapplication. • Theconceptsofdifferentformingprocessesandthustogetdesiredpartshape.Canidentifyth eeffectofprocessparametersontheoutputsandcanselectsuitableprocessparametervalues .					
CourseContents	1. Determination ofmoldingpropertiesofsodiumsilicatebondedsand 2. Studyoftheshrinkagebehaviorduringphasechangeprocesses 3. Studyofsheetmetalformingprocesses 4. Studyon thespring backinformingprocesses 5. Studyofinjectionmoldingprocess 6. Studyofmanualmetalarcweldingprocess 7. Studyofgasmetalarcwelding(GMAW)process 8. Studyofgastungstenarcweldingprocesses 9. Studyoffrictionstirweldingprocesses 10. Studyon processcontrolandoptimizationinweldingandcasting					
EssentialReading	1. S.Kalpakjian,S.R.Schmidt,ManufacturingEngineeringandTechnology,7th edition,PearsonIndia,2009.ISBN:978-0133128741 2. E.P.DeGarmo,J.T.Black,andR.A.Kohser,DeGarmo'smaterialsandprocesses in manufacturing,11th edition,JohnWiley&Sons, 2013. ISBN:978-8126540464					
Supplementary Reading	1. M.P.Groover,PrinciplesofModernManufacturing,5th edition,Wiley,2014.ISBN:978-8126547371					

CourseName	Introduction to DataManagement	CourseCode	CS2006			
Offered by Department	Computer Science&Engineering	Structure (LTPC)	2	0	2	3
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
LearningObjectives	• Thiscoursecoversthebasicconceptsofdatamanagement,databasesystems,anddatabaseapplications.					
LearningOutcomes	• Understandthefundamentalsofdatabasesystems,designtechniquesandtheiruseinorganizations; • Comprehendhowdatabasesystemsareusedforstrategicandoperationaldecisionmaking; • Understandmanagerialissuesassociatedwithdatabasetechnologies					
Course Contents(with approximate breakupofhoursforlecture/tutorial/practice)	NeedforEfficientDataManagement-DataModelling-EntityRelationshipModeling-RelationalSchema (5 L) SQLConstructs-DataTypes,DataDefinitionandManipulationLanguage-Key constraints-Basic ClausesofSQL query (5 L) BasicandAdvancedOperatorsinSQL,Functions-TableJoins-SQLSimpleandNestedQueries -Views (8 L) IntroductiontoMongoDBArchitecture-DatasetupandqueryinginMongoDB - Applicationdevelopmentusingcasestudies/courseprojects toconnectwithDatabases (10 L)					
EssentialReading	1. Fundamentals ofDatabaseSystems-RElmasri, SNavathe,Pearson,2017					
Supplementary Reading	1. W3 Schoolsonlinereferences /tutorials on SQL,MongoDB 2. LearningSQL:MasterSQLFundamentals,AlanBeaulieu,SecondEdition,O'Rielly,					

CourseName	Electrical Drives Practice	CourseCode	EC2006			
Offered by Department	Electronics & Communication Engineering	Structure(LTPC)	0	0	3	1.5
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	Basic Electrical Engineering	Approved In	Senate-44			
LearningObjectives	• To introduce the students to conventional and static methods to control various AC and DC drives used in Industry. • Also to deliver a thorough understanding on feedback control via interfacing various sensors for an automated system.					
LearningOutcomes	At the end of the course, a student will be able to, • Select proper sensors, electrical drive, signal conditioning circuit and controller for the required automation. • Design control algorithms for electric drives which achieve the regulation of torque, speed, or position in the above machines. • Develop Simulink® models which dynamically simulate electric machine and drive systems and their controllers.					
CourseContents	Experiments conducted in this course: • Various sensors incorporated with an understanding and hands on study towards Signal conditioning, Characteristics of Transducers, Calibration of sensors, and Measurement of various physical quantities. • Brings out the basic concepts of different types of electrical machines and their performance. • 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. • Familiarize various power electronic converters and static control of drives. • Introduces Speed-Torque characteristics of various types of load and drive motors.					
EssentialReading	1. IIITDM Kancheepuram Electrical Drives Practice Manual					
Supplementary Reading	1. Gopal K. Dubey, Fundamentals of Electrical Drives, 2nd edition, Narosa, January 2010, ISBN-13 : 978-8173194283 2. R. Krishnan, "Electric Motor Drives: Modeling, Analysis, and Control," Prentice Hall, 2001. 3. Ned Mohan, Electric Machines and Drives: A First Course, 1st edition, Wiley, 2012.					

<table>
<tr><td>Course Name</td><td>Smart ProductDesign</td><td>Course Code</td><td colspan="4">DS2001</td></tr>
<tr><td>Offered by Department</td><td>SIDI</td><td>Structure (LTPC)</td><td>1</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td>To be offered for</td><td>B. Tech</td><td>Course Type</td><td colspan="4">Core</td></tr>
<tr><td>Prerequisite</td><td>SystemsThinking forDesign</td><td>Approved In</td><td colspan="4">Senate-43</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objective of this course to help the students understand and apply the concepts of designing smart/intelligent products, i.e., information intensive and contextsensitive</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will:
• Identify and define the right type of intelligent behavior for a chosenproduct concept
• Design high-level functional and component (structural) architecture forintelligent behavior using appropriate metaphor and analogy
• Evaluate and select the right AI technique for the proposed functional andcomponent architecture and vice versa</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">Module 1: Introduction to intelligence behavior (9 hours)
• Definition of intelligence
• Dimensions of intelligence
• Levels of intelligence

Module 2: Architecture for intelligent behaviour (15 hours)
• Functional arch for Intelligent Behaviour (Intelligence and information
• intensity relation (equilibrium, amplification))
• Biological metaphors for cyber-physical systems (Bio-inspired adaptive
• systems (Positive and negative feedback)
• Theory of living systems (Self evolve, self-improve, self-aware (e.g., self-configuration, -organization, -optimization) properties)

Module 3: Selection of appropriate AI Techniques (18 hours)
Rule-based systems - Fuzzy inferencing - Artificial neural networks -
• Evolutionary computation -
• determine which type of intelligent system methodology would be suitable
• for a given type of application problem
• Demonstrate a working prototype, in the form of a major project work, the
• ability to design and develop an intelligent system for a selected application.
• Poster Session
• Evaluation: Continuous assessment (40%); Final concept presentation (20%); EndSem(40%)</td></tr>
<tr><td>Essential & Supplementary Reading</td><td colspan="6">1. Donald A Norman (2007), The design of future things, Basic Books, New York
2. Dario Floreano and Claudio Mattiussi (2008), Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, MIT Press
3. Michael Negnevitsky (2005), Artificial Intelligence: A Guide to Intelligent Systems, Second Edition, Addison Wesley</td></tr>
</table>

CourseName	ManufacturingProcesses-2	Course Code	ME2007			
Offered by Department	MechanicalEngineering	Structure(LTPC)	3	1	0	4
To be offered for	B.Tech.	Course Name	Core			
Prerequisite	Materials for Engineers,ManufacturingProcesses	Approved In	Senate-44			
LearningObjectives	Tostudythefundamentalsofmachiningprocesses andmachinetools.					
LearningOutcomes	●Attheendstudentswillbeabletoselectandapplyasuitablemachiningprocessandcuttingtoolu ponthework piecematerialand geometry. ●Attheendstudentswillbeabletoidentifythemachiningdefectsandsolutiontoovercome the same. ●Attheendstudentswillbe ableto utilizethe powdermetallurgyconcepts.					
CourseContents(with approximatebreak up ofhoursforlecture/tutorial/practice)	**MachiningandCuttingTool:** (6 L+ 2 T) Materialremoval.Elements,fundamental,mechanismofdeformationin metalcutting.Geometry&designofsingleandmulti-pointtool **Mechanics ofChipFormation:** (6 L+ 2 T) Orthogonal&oblique cutting,mechanismofchipformation,chiptypes,mechanicsofmachining.Forcesandstresses ontoolanditsdistribution,cuttingforcemeasuringtechnique. **Heatflowinmetalcuttingand toollife:** (6 L+2 T) Heatflowinprimary,secondaryandtertiaryzones,tooltemperaturemeasurement,temperat uredistributionintool.Machinability,toollife,Taylor'sequation,toolfailure,economicsin metalmachining. **CuttingToolmaterialand Cuttinglife:** (8 L+ 3 T) Toolmaterials,Alloyingelementsintoolsteel.Carbonsteel,highspeedsteels,co-castalloys,carbidetools,ceramictools,diamond.Function&requirementofcuttingfluid.Typ e ofcuttingfluid.Methodofapplicationofcuttingfluids. **AbrasiveMachiningProcessesandBroaching:** (8 L+ 3 T) Abrasiveprocesses,grindingwheel-specificationsandselection,typesofgrindingprocess,concepts ofsurfaceintegrity,broachingmachines,broachconstruction**ProcessingofPowdermetals:** (8 L+ 2 T) Productionandcompactionofmetalpowders,sintering,designandprocesscapabilities.Form ing,shapingandmachiningofceramics.Processingsemiconductors,elastomers,metalmatri					
EssentialReading	1. S.Kalpakjian,S.R.Schmidt,ManufacturingEngineeringandtechnology,7th edition,Pear sonIndia,2009.ISBN:978-0133128741 2. M.P.Groover,PrinciplesofModernManufacturing,5thedition,Wiley,2014.978-8126547371.					
SupplementaryReading	1. E.P.DeGarmo,J. T. Black,and R.A. Kohser,DeGarmo'smaterials and processesin manufacturing,11th edition,JohnWiley&Sons, 2013. 2. 2.D.A.Stephenson,andJ.S.Agapiou,Metalcuttingtheoryandpractice,CRCPress,2005.					

<table>
<tr><td>Course Name</td><td>Thermal and Fluids Engineering</td><td>Course Code</td><td colspan="4">ME2014</td></tr>
<tr><td>Offered by Department</td><td>Mechanical Engineering</td><td>Structure (LTPC)</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>To be offered for</td><td>B.Tech.</td><td>Course Type</td><td colspan="4">Core</td></tr>
<tr><td>Prerequisite</td><td>NIL</td><td>Approved In</td><td colspan="4">Senate-44</td></tr>
<tr><td>LearningObjectives</td><td colspan="6">● To introduce different concepts and governing equations for thermodynamics and fluid mechanics.
● To apply the learned concepts to a few real-life cases.</td></tr>
<tr><td>LearningOutcomes</td><td colspan="6">At the end of this course the students will be able to
● Understand and apply the concepts of thermodynamics, fluid mechanics and heat transfer.
● Analyze different thermodynamic cycles used in practical cases.
● Solve various basic fluid mechanics and heat transfer problems as a foundation for advance courses</td></tr>
<tr><td>CourseContents</td><td colspan="6">Thermodynamics (L8+T3)
Laws of thermodynamics - zeroth, first and second, concept of temperature, energy, and entropy,Calculations for work and heat transfer for a system and control volume
Fluid Mechanics (L18+T6)
Fluid properties – Density, viscosity, surface tension, capillary action
Fluid statics, concepts of pressure, stability of submerged and floating object
Fluid Dynamics – Lagrangian and Eulerian definition, concept of velocity and acceleration, equations of continuity and momentum, Bernoulli's equation, flow through pipes, laminar and turbulent flows,Dimensionless analysis
Heat Transfer (L16+T5)
Conduction – Fourier law, 1-D conduction, rectangular and polar coordinate system, insulation,
Convection – forced convection, natural convection, thermal and hydraulic boundary layer
Radiation – basic concepts and application</td></tr>
<tr><td>EssentialReading</td><td colspan="6">1. YunusCengel; Robert Turner, Fundamentals of Thermal-Fluid Sciences, McGraw-Hill Higher Education, 3rd edition 2008.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Cengel, Y.A. and Boles, M.A., 2007. Thermodynamics: An Engineering Approach 6th Edition (SI Units). The McGraw-Hill Companies, Inc., New York.
2. Introduction to fluid mechanics and fluid machines, S Som, G Biswash, S Chakraborty, 3e. Tata McGraw-Hill Education, 2017.
3. Bergman, T.L., Incropera, F.P., Lavine, A.S. and Dewitt, D.P., 2011. Introduction to heat transfer. John Wiley & Sons.</td></tr>
</table>

CourseName	OperationsResearch	Course Code	ME2015			
Offered by Department	MechanicalEngineering	Structure(LTPC)	3	0	0	3
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved By	Senate-44			

LearningObjectives	• Tolearnvarioustoolsandquantitativetechniquesforsolvingbusinessdecisionproblemsandfindingoptimalsolutionsandbuildcapabilitiesinstudentstoanalyzedifferentproblematicscenariosin industriesinvolvinglimited resourcesandeffectivedecisionmaking
LearningOutcomes	• Abilitytounderstandandanalyzethereallifeoperationalproblemswhichinvolvesresourceconstraints • Abilitytoformulatemathematicalmodelto variousIndustrial/businessdecisionproblems • Abilitytouseappropriatetoolsandtechniquestosolvevariousindustrial/businessdecisionproblems,determinetheoptimalsolutionandto makeeffectivebusinessdecisions.
CourseContents(withapproximatebreakupofhoursforlecture/tutorial/practice)	**IntroductiontoOR:**RoleofOperationsresearchindecision-making,typesofORTechniques,andconstructingthe model. (L2) **LinearProgramming:**Introduction,Assumptions,FormulationofLPProblem,Applicationsand Limitations (L4) **LinearProgrammingTechniques:**GraphicalMethod,Algebraicmethod,SimplexMethod,Big Mmethod,Twophasemethod,Degeneracy,AlternateOptimum,unboundedness,infeasibility,LP Solvers (L10) **DualityandSensitivityAnalysis:**ImportanceofDualityconcepts,Formulation**of**Dualproblems,DualSimplex,SensitivityAnalysis (L4) **TransportationProblem:**Leastcostmethod,NorthWestcornerrule,Vogel'sapproximationmethod,MODImethod,degeneracyin transportationmodel,unbalancedand maximizationmodels. (L6) **AssignmentProblem:**Differencebetweentransportationproblemandassignmentproblem,Hungarianalgorithm,unbalancedassignmentproblems, RoutingProblems,travelingsalesmanproblem (L6) **IntegerProgrammingProblem:**Introduction,TypesofIPP,Formulation,roundingoffAlgorithm,Branchand BoundAlgorithm (L4) **ProjectScheduling:**Basicterminologies,constructinga projectnetwork,CPMandPERT (L4) **Queuingmodels**:Notationofqueues,performancemeasures,TheM/M/1andM/M/mqueue (L3) **Production Scheduling:** SingleMachineFlow shopandJob ShopScheduling(L2)
EssentialReading	1. HamdyATaha, "OperationsResearch– AnIntroduction",PearsonEducation,NewDelhi,2014. 2. G.Srinivasan, OperationsResearchPrinciples and Applications,PHI,3rd Edition 3. R. Paneerselvam,OperationsResearch,PHI, 2nd Edition
SupplementaryReading	1. A.Ravindran,,D.T.Phillips,J.SolbergOperationResearch:PrinciplesandPractice,WileyEdition,Newyork. 2. FrederickS.HillerandGeraldJ.Lieberman,Inroductionto OperationsResearch,McGraw-Hill,2012

CourseName	Production Drawing Practice	CourseCode	ME2016			
Offered by Department	MechanicalEngineering	Structure(LTPC)	0	0	3	1.5
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	Basics ofEngineeringGraphics	Approved In	Senate-44			
LearningObjectives	Developthenecessaryskills to prepareproductiondrawings and 3D modelling					
LearningOutcomes	At the end of the course, a student will be able to: • Represent and understand drawing symbols and geometric dimensioning and tolerance • Create 3D models of parts and assembly, and exploded views of assembly using CAD software • Prepare production drawings of machine components					
CourseContents	**Representation:** Layout of drawing sheet, title block, conventional representation of materials, machine components, welding symbols, hydraulic, pneumatic symbols, surface roughness symbols. (P9) **Limits, Fits and Tolerances:** Types of fits, exercises involving selection/interpretation of fits and estimation of limits from tables. (P3) **Form and Positional Tolerances:** Introduction and indication of the tolerances of from and position on drawings, deformation of runout and total runout and their indication. (P6) **3D Part Modelling and Assembly:** Development of 3D models of machine components using CAD software, assembly of machine components and drafting of assembly using CAD software with fits. (P9) **Production Drawings:** Creation of production drawings of parts with indications of size, dimensional and geometric tolerances, welding and surface roughness symbols, form and position errors using CAD software. (P12)					
EssentialReading	1. G. Bertoline, E. Wiebe, N. Hartman and W. Ross, Technical Graphics Communication, 4th edition, Tata McGraw Hill, 2008.					
SupplementaryReading	1. J.D.Meadows,GeometricDimensioningandTolerancing,CRC Press,2009.					

CourseName	ManufacturingProcessesPractice-2	CourseCode	ME2010			
Offered by Department	MechanicalEngineering	Structure	0	0	3	1.5
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	Basics ofManufacturingProcesses	Approved In	Senate-44			
LearningObjectives	Tostudyandpracticethevariousoperationsthatcanbe performedinlathe,millingmachinesetc.andtoequipwiththepracticalknowledgerequiredinthecoreindustries.					
LearningOutcomes	Attheend ofthiscoursethestudentwillbeableto selectandapply • Methodstosolveproblemsoncuttingforces,toollifeandanalytical methods ofestimatingcuttingtemperature. • Suitablemachiningoperationstosubtractiveremovethematerialsandthusto getthecomponent/work piecewithdesiredgeometry.					
CourseContents	**LatheExercises** Machiningand machiningtimeestimationsfor ● TaperTurning ● ExternalThreadcutting ● InternalThreadCutting ● Knurling **MillingExercises** ● Simpleprismaticparts ● Contourmillingusingverticalmillingmachine ● Spurgearcuttingin millingmachine ● Helicalgearcuttingin millingmachine **DrillingExercises** ● EffectofPrimaryCuttingEdges ● EffectofSecondaryCuttingEdges **GrindingExercises** ● PlainSurfacegrinding ● Cylindricalgrinding **Determination ofmaterialremovalrate** **invariousprocessesMeasurement ofcuttingforcesin**					
EssentialReading	1.S.Kalpakjian,S.R.Schmidt,ManufacturingEngineeringandTechnology,7th edition,PearsonIndia,2009.ISBN:978-0133128741					
Supplementary Reading	1. M.P.Groover,PrinciplesofModernManufacturing,5thedition,Wiley,2014.ISBN:978-8126547371					

CourseName	EmbeddedSystemsPractice	CourseCode	EC2012			
Offered by Department	Electronics&CommunicationEngg.,	Structure(LTPC)	1	0	2	2
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
LearningObjectives	Tofamiliarize withthe design and implementation ofdifferentembeddedsystems with real timeapplications.					
LearningOutcomes	Thecoursewouldequipthestudents todesignembeddedsystems usingARMSoCplatforms. Theywouldalsobe familiarizedwiththe usage ofRTOSforsystemdesign and IoTsystemsdesign.					
CourseContents(withapproximatebreakup ofhoursforlecture/tutorial/practice)	ImplementationofembeddedsystemsTivaLaunchpad andTM4C microcontrollersetupandParallelI/O:LEDsandswitches. EmbeddedsystemsdesignusingARMCortex, SteppermotorandServomotorinterfacing,Real-timeoperatingsystems in embeddedsystems.					
EssentialReading	1. J.W.Valavano,EmbeddedSystems:IntroductiontoArm®Cortex (TM)-MMicrocontrollers, 5thedition,CreateSpace, 2012, ISBN-10:1477508996,ISBN-13:978-1477508992. 2. A.S.Berger,EmbeddedSystemsDesign:AnIntroductiontoProcesses,Tools,andTechniques,CMP,2002.ISBN:1578200733. 3. J.W.Valavano,EmbeddedMicrocomputerSystems:RealTimeInterfacing,2nd edition,CreateSpace,2006. ISBN0534551629.					
SupplementaryReading	1. J.W.Valavano,EmbeddedSystems:Real-TimeInterfacingto Arm®Cortex(TM)-MMicrocontrollers,2nd edition,CreateSpace,2011.ISBN-10:1463590156,ISBN-13:978-1463590154.					

CourseName	MachinetoMachineCommunication	Course Code	CS2013			
Offered by Department	Computer Science&Engineering	Structure(LTPC)	2	0	2	3
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
LearningObjectives	• Tointroducethe basicconceptsandtechniquesofMachinetoMachineCommunication. • How to integratesuchtechnologyinto existinginfrastructure					
LearningOutcomes	• Studentscan ableto Identifythe mainchallengesassociatedwithM2M • Communicationstoday,canable tolistthe mainstandards,protocols,algorithms, and researchactivitieswhichaddressthesechallengesoftoday.Can ableto identifylimitsofstandards/protocolsand algorithms withrespecttoM2Mcommunications					
CourseContents(withapproximatebreakup ofhoursforlecture/tutorial/practice)	IntroductiontoM2M;M2MCurrentLandscape;EarlyimplementationsanddeploymentofM2M communications. (L4+P2) IntroductiontoTCP/IP,OSIreferencemodelnetworkingcommands:Ping,Traceroute,IPconfig, UDP,congestioncontroland avoidance (L4+P2) ConnectingtwonodesusingEthernetcableandstudytheperformanceevaluationparameterssuchasdelay,effectivebandwidthusingsocketProgramming.(L2+P2hrs) M2MTerminalsandModules–HardwareInterfaces– Power,USB,UART,Antenna,UICC,GPIO,SPI,I2C,ADC,PCM,PWM and AnalogAudio, Service,SoftwareInterface. (L4+P4) M2MArchitectureandProtocols– M2MRequirementsandHighLevelArchitecturalPrinciples.HighLevelArchitecturePrinciplesforM2MCommunications. (L4+P2) M2MServiceArchitectures– HighLevelServiceArchitecture;ETSITCM2MServiceCapabilitiesFramework,M2MserviceCapabilities,M2MResourcebasedM2MCommunicationandProcedures. (L4+P2) SmartCardsinM2M Communication – SecuritvandPrivacvissuesin M2M					
EssentialReading	1. D.Boswarthick,O.Elloumi,andO.Hersent,M2MCommunications-ASystemApproach,Wiley,ISBN 978-1-119-99475-6. 2. D.Minoliauth,Buildingthe InternetofThingswithIPv6 and MIPv6 The EvolvingWorld ofM2MCommunications,Wiley,ISBN:978-1-118-47347-4. 3. C. Anton-Haro, M. Dohler, Machine-to-Machine (M2M) Communications-Architecture,Performance and Applications,Woodhead,ISBN 978178242102.					
SupplementaryReading	1. O.Hersent,D.Boswarthick andO.Elloumi,TheInternetofThings:KeyApplicationsandProtocols,Wiley, 2nd edition, 2012, ISBN:978-1-119- 99435-0. 2. J.Brazell,L.Donoho,J.Dexheimer,R.HannemanandLangdon,M2MTheWirelessRevolution,technicalreport,Innovation -Creativity– CapitalInstitute,UniversityofTexasat Austin. 3. W. Webb,UnderstandingWeightlessTechnology,Equipment, and NetworkDeploymentforM2MCommunications inWhiteSpace,Cambridge,ISBN-					

Course Name	Introduction to Data Science for Engineers	Course Code	CS3006			
Offered by Department	Computer Science and Engineering	Structure (LTPC)	3	0	2	4
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	This course covers the basic concepts of Data Science to help the student to learn, understand and practice data analytics encompassing concepts from descriptive, inferential statistics and predictive techniques and big data concepts.					
Learning Outcomes	• Ability to identify the characteristics of datasets; Ability to select and implement machine learning techniques suitable for the respective application; • Ability to solve problems associated with big data characteristics such as high dimensionality; • Ability to integrate machine learning libraries and mathematical and statistical tools					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Introduction to relevant industry applications and analytics – Descriptive Statistics – Data Visualization & Interpretation -Measures of Central Tendency & Dispersion - Basic and advanced plots such as Stem-Leaf Plots, Histograms, Pie charts, Box Plots, Violin Plots etc. – Merits of Demerits & Interpretation (10) • Inferential Statistics – Hypothesis Testing - Tests of Significance – Analysis of Variance - Regression – Linear and Logistic (8) • Predictive Analytics – Supervised and Unsupervised – Association Rules, Classification, Clustering, Outlier Analysis, Time Series Modeling (14) • Big Data Characteristics – Map Reduce – Deduplication, Distributed Storage, Implementation using Hadoop / Spark platforms (8) • **Practice Component:** Concepts from Descriptive Statistics, Inferential and Predictive Analytics would be test driven using platforms such as Python, R etc. ML support in these platforms for rule mining and application, classification & clustering algorithms etc. would also be test driven as part of the practice exercises. Modern technologies for big data handling such as Spark – support for Map reduce would also be test driven. Applications relevant to the student's stream of specialization would be explored for exercises / course project as case studies. (14 sessions – weekly exercises)					
Essential Reading	1. J Han, M Kamber, Data Mining Concepts & Techniques, Elsevier, 3rd Edition, 2007, ISBN 9780123814791					
Supplementary Reading	1. Joel Grus, Data Science from Scratch, Orielly, 2ndEdn, 2019, ISBN 9781492041139 2. Leskovec, AnandRajaraman,, Ullmann, Mining of Massive Data Sets, Cambridge University Press, Open Source free version , ISBN 9781107015357 3. P Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017, iSBN 9789352135653					

Course Name	EntrepreneurshipandManagement Functions	Course Code	DS3000			
Offered by Department	SIDI	Structure(LIPC)	1	2	0	3
To be offered for	B.Tech	Course Type(Core/Elective)	Core			
Prerequisite	SystemsThinkingandDesign	Approved In	Senate-43			
Learning objectives	The objective of this course is toprovide engineering students an exposure tothe basic conceptsofentrepreneurshipandmanagement,withaspecificfocusontheprocessofturninganideaint oacommerciallyviableventure.					
Learning Outcomes	Attheendofthecourse,thestudentswilllearnhowto • Understand the market & competition • Prepareabusinesscaseforthe product/idea					
Contentsofthe course	Module1:Introduction • Divisionoflaborandcreationofvalue • Evolutionoforganizations,industriesandsectors,forprofitandnon-profit • RoleofEntrepreneursandManagersinvaluecreation • PrinciplesofManagement-Planning,Organizing,Resourcing,Directing (4) Module2:Strategy&Planning • Understandingindustrydynamics&competition(Porter'sFramework) • Understandingtheindustryvaluechainandfirmpositioning (6) Module3:Organizing • Typicalorganizationalfunctions(R&D,Marketing&Sales,HR,Operations) • Cyberneticsoforganizationalfunctions(StaffordBeer'sviablesystemsmodel) • Typesoforganizationstructures(product,functional,matrix,global) (6) Module4:ResourceManagement • Financialmanagement(Sourcesoffunding,howtoreadaP&L,balancesheet) • Humanresourcemanagement(Interviewing,compensation,motivation) • Globalsourcingandsupplychainmanagement (8) Module5:ManagementInformation&DecisionMaking (4) Module6:LegalandRegulatoryenvironment (4)						
Essential Reading	1. PeterFDrucker,*ThePracticeofManagement*,HarperCollins,2006,ISBN:978-0060878979 2. HentryMintzberg,*Managing*,Berret-KoehlerPublishers,2009,ISBN:978-1605098746 3. MichaelPorter,*Oncompetition:UpdatedandExpandedEdition*,HBS,2008,ISBN:978-1422126967 4. VasantaDesai,*DynamicsofEntrepreneurialDevelopmentandManagement*,HimalayaPublishingHouse,ISBN:9788183184113.					
Supplementary Reading	1. WalterIsaacson,*SteveJobs*,2011,ISBN:978-1451648539 2. EricRies,*TheLeanStartup*,PortfolioPenguin,2011,ISBN:978-0307887894 3. VineetBajpai,Buildfromscratch,Jaicobooks,2013,ISBN:9788184952919.					

Course Name	Operationsand SupplyChainManagement	CourseCode	ME3004			
Offered by Department	MechanicalEngineering	Structure(LTPC)	3	0	0	3
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
LearningObjectives	• Thecourseaimstoprovideanin-depthcoverageofoperationsmanagementandsupplychainmanagement. • Studentswillbeexposedtovariousaspectssuchasproductionplanning,forecasting,regressionanalysis,transportationmodels,topicsin supplychainetc.					
LearningOutcomes	• Thecoursewouldequipstudentswithskillsrequiredforeffectivedecisionmakingandmanagement					
CourseContents(withapproximatebreakup ofhoursforlecture/tutorial/practice)	OperationsManagement:Introduction,TypesofProductionSystems,Facilitylocationandlayouttechniques.MaterialsRequirementPlanning(MRP). (L3) ProductionScheduling-Singlemachine,Flowshop.WorkStudy-MethodStudy-RecordingTechniques-Therblig-SIMOchart.Forecastingmethods-Qualitativemethods,QuantitativeModels-Timeseriesforecastingmodels,movingaverages,exponentialsmoothing withtrendandseasonaladjustment,multi-itemforecasting,Simpleand multiplelinearregressionmodels (L11) NetworkDesigninSupplyChain:IntroductiontoSupplychain,Roleofdistributioninsupplychain–networkdesigninthesupplychain–modelsforfacilitylocationandcapacityallocation–Impact of uncertaintyonnetworkdesign.Inventory (L10) ManagementinSupplyChain:Cycleinventory–multi-echeloninventory–safetystockinthesupplychain–safetylevelestimation,supplyuncertainty,dataaggregation,replenishmentpolicies,managingsafety,inventory in practice–productavailability–optimallevel,affectingfactors,supplychaincontracts. (L13) TransportationinSupplyChain:DesignoptionsforTransportationnetwork,trade-offs,					
EssentialReading	1. S.L.Davi, K. Philipand S.L.Edith,Designingand Managingthe SupplyChain,TataMcGraw-Hill,2003. 2. R.Panneerselvam,Production and operationsmanagement,Prentice-HallofIndia,2010					
Supplementary Reading	1. A. Ravi Ravindran , Operations Research and Management Science Handbook, 1st Edition., 2007 by CRC Press					

Course Name	Robotics and Automation	Course Code	ME3005			
Offered by Department	Mechanical Engineering	Structure (LTPC)	3	0	0	3
To be offered for	B.Tech.	Status	Core			
Pre-requisite	NIL	Approved In	Senate-44			
Learning Objectives	To introduce the students to various state of art automation technologies in manufacturing and the role of robots in automation.					
Learning Outcomes	At the end of the course, a student will be able to • Design robots with application in manufacturing automation. • Automate a manufacturing system with various sensors, actuators and controllers.					
Contents of the course *(With approximate break up of hours)*	**Automation Systems-Overview:** Overview of mechatronic and automation systems and devices, automated feeding, transfer, retrieval mechanisms and devices, AGVs, FMS workstations, material handling and storage systems, overview of sensors, transducers, control systems and microfluidic devices in automation. (7 L) **Robots in Automation:** Robot classification and anatomy, forward and inverse kinematics, DH matrix transformation, Jacobian and differential motion, Trajectory planning, Static and dynamic analysis, Grippers and other hardware, Vision systems, Mobile and parallel robots. (15 L) **Pneumatic Systems:** Production, distribution and conditioning of compressed air, system components and graphic representations, design of pneumatic circuits. (7 L) **Hydraulic Systems:** Hydraulic systems: flow, pressure and direction control valves, actuators, supporting and control elements, pumps, servo valves and actuators, proportional valves and their applications, design of hydraulic and performance analysis. (7 L) **Controllers:**Types, Force feedback, Visitation-assisted robot control, Programming and PLC interfacing, IoT enabling. (7 L)					
EssentialReading	1. Anthony Esposito, Fluid power with applications, 7th Edn., 2014, Prentice Hall. 2. M P. Groover, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill, 2nd Edn., 2012, ISBN: 9780070265097. 3. Craig J.J., "Introduction to Robotics: Mechanics and Control ", Prentice Hall, 4th Edn, 2017, ISBN: 978-0201543612.					
Supplementary Reading	1. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th edition, Pearson India, 2015. ISBN: 9788131732533. 2. HMT Ltd., Mechatronics, Tata–Mcgraw Hill, 2000, ISBN: 9780074636435. 3. Deb, S. R., Robotics technology and flexible automation, Tata McGraw-Hill, 2nd Edn. 2017. 4. Boucher, T. O., Computer automation in manufacturing - an Introduction, Chapman and Hall, 2013. 5. Morris A. Cohen and Uday M. Apte, Manufacturing Automation, McGraw Hill, New York, 1997, ISBN 0-256- 14606-3.					

CourseName	QualityEngineering	CourseCode	ME3006			
Offered by Department	MechanicalEngineering	Structure(LTPC)	2	0	2	3
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
LearningObjectives	Toimpartknowledge oninspection,measurement,qualitycontrol, validation andcertificationofproducts.					
LearningOutcomes	Attheend ofthecourse, astudentwillbe ableto: • Understandvariousmetrologyprinciplesandtechniques • Identifyandselectsuitabletechniquesandequipment'stoinspectandtoensurepr oductquality • Know about various quality control methodologies, standards andcertifications					
CourseContents(wit happroximatebreaku p ofhoursforlecture/tut orial/practice)	**Basicconcepts:**Measurementandinspection;Roleofmetrologyinqualityassurance ; Errors; Lengthstandards; Gauges andcomparators;Linearandangularmeasurements;Fits andtolerances. (7 L+8 P) **MeasurementPractices:**Opticalmetrologyandlaserinterferometers;Measureme ntofflatness,straightnessandformerrors;Surfacefinishmeasurements;CMM;Visio napplicationsinMetrology;Nano-measurements. (8 L+8 P) **StatisticalMethodologies:**Graphicalmethods,Statisticalcontrolcharts,Regressi onanalysis,Analysis of variance,Samplingandacceptance. (10L+8P) **Casestudies:**InspectionandValidationpracticesadoptedinvariousindustries. (3 L+4 P)					
EssentialReading	1. T.G.Beckwith,R.D.MarangoniandJ.H.Lienhard,MechanicalMeasurements,6 th edition,PearsonHigherEducation,2007,ISBN:0132296071. 2. R.K.Jain,EngineeringMetrology,KhannaPublishers,20th Reprint,2014,ISBN :817409153X.					
Supplementary Reading	1. D.J.Whitehouse,Handbookofsurfaceandnanometrology,2nd Edition,CRCPres s, 2010, ISBN:9781420082012. 2. G. T. Smith,IndustrialMetrology,Springer,2002,ISBN:9781852335076. 3. A.M.Badadhe,MetrologyandQualityControl,TechnicalPublications,2006,ISB N:8189411861. 4. R.C.Gupta,StatisticalQualityControl,8th edition,KhannaPublishers,2008,ISB N:8174091114.					

Course Name	Robotics and Automation Practice	Course Code	ME3007			
Offered by Department	Mechanical Engineering	Structure (LTPC)	0	0	2	1
To be offered for	B.Tech.	Course Type	Core			
Pre-requisite	NIL-	Approved In	Senate-44			
Learning Objectives	To introduce the students to various state of art automation technologies in manufacturing and the role of robots in automation.					
Learning Outcomes	At the end of the course, a student will be able to • Design robots with application in manufacturing automation. • Automate a manufacturing system with various sensors, actuators and controllers.					
Contents of the course *(With approximate break up of hours)*	Integration of various sensors, actuators, vision systems and other mechatronic devices in automation Computer based design, simulation and robot analysis Design, development and implementation of pneumatic and hydraulic circuits Programming and integration of PLCs, controllers and IoT devices in automation					
Essential Readings	1. Anthony Esposito, Fluid power with applications, 7th Edn., 2014, Prentice Hall. 2. M P. Groover, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill, 2nd Edn., 2012, ISBN: 9780070265097. 3. Craig J.J., "Introduction to Robotics: Mechanics and Control ", Prentice Hall, 4th Edn, 2017, ISBN: 978-0201543612.					
Supplementary Readings	1. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th edition, Pearson India, 2015. ISBN: 9788131732533. 2. HMT Ltd., Mechatronics, Tata–Mcgraw Hill, 2000, ISBN: 9780074636435.Deb, S. R., Robotics technology and flexible automation, Tata McGraw-Hill, 2nd Edn. 2017. 3. Boucher, T. O., Computer automation in manufacturing - an Introduction, Chapman and Hall, 2013. 4. Morris A. Cohen and Uday M. Apte, Manufacturing Automation, McGraw Hill, New York, 1997, ISBN 0-256- 14606-3. 5. AshitavaGhoshal, "Robotics Fundamental Concepts & Analysis", Oxford University Press; 2006, ISBN: 9780195673913 6. K. S. Fu, Robotics: control, sensing, vision and intelligence, Mcgraw-Hill,1987.					

<table>
<tr><td>Course Name</td><td>Prototyping & Testing</td><td>Course Code</td><td colspan="4">DS3001</td></tr>
<tr><td>Offered by Department</td><td>SIDI</td><td>Structure(LT PC)</td><td>1</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td>To be offered for</td><td>B.Tech</td><td>Course Type</td><td colspan="4">Elective</td></tr>
<tr><td>Prerequisite</td><td>NIL</td><td>Approved In</td><td colspan="4">Senate-43</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objective of the course is to help students develop rapid prototyping skills andrealize aminimumviableproduct</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Students will develop skills in rapid prototyping; project management and focusingondeliveringoutcomes</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">1. Minimumviableproductplan(3hours)
• Markets andNeeds
• Business Goals
• Keyfeatures
2. CoreProductArchitecture(6hours)
• Storyboardingofthe product core.
• Frameworkformechanical,electronicsandcomputingparadigm
3. DesignforManufacture&Assembly(3hours)
• ManufacturingProcess:Form
• Assemblyconstraints:Fit
4. DevelopingtheProofofConcept(30hours)
• Build
• Assemble
• Iterate
• Validate
• Pitch
Evaluation:Continuousassessment(80%);FinalPoCdemo (20%)
2 one-day hackathons may be organized during this period (one weekends) toacceleratePoC development</td></tr>
<tr><td>Essential & Supplementary Readings</td><td colspan="6">1. How to Solve Big Problems and Test New Ideas in Just Five Days by Jake Knapp,JohnZeratsky,BradenKowitz
2. TheTotalInventorsManual: Transform YourIdeaintoaTop-SellingProduct by SeanMichaelRagan
3. PrototypingandModel makingforProductDesignbyBjarkiHallgrimsson
Bringing a Hardware Product to Market: Navigating the Wild Ride from ConcepttoMassProductionby ElaineChen</td></tr>
</table>

Course Name	Professional Communication	Course Code	HS3000			
Offered by Department	SH-English	Structure (LTPC)	1	0	2	2
To be offered for	B.Tech.	Course Type	Core			
Prerequisite	NIL	Approved In	Senate-44			
Learning Objectives	• Develop the capability to apply for a job and participate in selection process • Acquire interview skills • Gain proficiency in language skills indispensable for a successful professional • Develop emotional intelligence					
Learning Outcomes	• Prepare résumé and cover letter • Ready to perform at different levels of the interview process • Able to use interpersonal skills in challenging situations • Competent to draft various documents for specific purposes					
Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)	• Preparing cover letter, résumé, digital profile; video profile; Email etiquette (L2, P4) • Interview skills, Group discussion and impromptu speech (L2, P6) • Social communication skills (L4, P6) ➢ Conversational English appropriateness, context based speaking in general situations, discussion and associated vocabulary in professional situations) ➢ Non-verbal communication – relevance and effective use of paralinguistic features – body language, chronemics, haptics, proxemics ➢ Emotional intelligence (EI) and social intelligence at workplace – theoretical perspectives and their application in relevant workplace situations – EI and leadership skills – assessments and best practices in organizations • Conflict management and communication at workplace (L4,P6) ➢ Cross-cultural communication, Argumentation, negotiation, persuasion, decision making, case study of challenging situations ➢ Organizing a meeting, working as part of a team, briefing ➢ Business presentations – Preparing effective presentations, delivering presentations and handling questions • Writing proposals, statement of purpose, research article, agreements, summary Proofreading (L1, P4) • Training for proficiency assessment (L1,P2)					
Essential & Supplementary Readings	1. Tebeaux, Elizabeth, and Sam Dragga. *The Essentials of Technical Communication*. OUP, 2018. 2. Sabin, William A. *The Gregg Reference Manual: A Manual of Style, Grammar, Usage, and Formatting.* McGraw-Hill, 2011, pp 408-421. 3. Raman, Meenakshi and Sangeeta Sharma. Technical Communication: Principles and Practice. OUP, 2015. 4. Caruso, David R. and Peter Salovey. *The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership*. John Wiley and Sons, 2004. 5. https://learnenglish.britishcouncil.org/business-english/youre-hired/episode-01 6. https://www.youtube.com/watch?v=HAnw168huqA 7. https://www.youtube.com/watch?v=azrqlQ_SLW8 8. https://owl.purdue.edu/owl/purdue_owl.html 9. Turabian,Kate L. *Student's Guide to Writing College Papers*. University of Chicago Press, 2010.					