

Indian Institute of Technology Bhubaneswar

Curriculum

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Compliance Report

Components	Subjects	Credit Recommended	Credit Approved
1. Common Core	(i) English	4	4
	(ii) Basic Science and Mathematics	20	20
	(iii) General Sciences	6	6
	(iv) Engineering Sciences	27	27
2. Breadth Basket	(i) Breadth-1	12-14	3/4
	(ii) Breadth-2		3
	(iii) Breadth-3		3/4
	(iv) Breadth-4		3/4
3. Miscellaneous	(i) Seminar	14	2
	(ii) Internship		2
	(iii) Project		10
4. Laterals	(i) Lateral-1	9-12	3
	(ii) Lateral-2		3/4
	(iii) Lateral-3		3/4
5. Verticals	Theory	58-68	2 nd year - 20
			3 rd year - 23/24
			4 th year - 19/25
	Laboratory	18-24	18
TOTAL		168-189	172/184

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1st Semester and 2nd Semester (Common to All Disciplines of Study)

SEMESTER - I					
Subject Name	Code	L-T-P	Credit	Contact Hour	Syllabus Page No.
Mathematics-1	MA1L001	3-1-0	4	4	4
Physics/ Chemistry	PH1L001/ CY1L001	3-1-0	4	4	5-6
Mechanics / English for Communications or Learning English	ME1L001/ HS1L001 or HS1L002	3-1-0/ 3-0-2 or 3-1-0	4	4/ 5 or 4	6-9
Electrical Technology / Introduction to Programing and Data Structures	EE1L001/ CS1L001	3-1-0	4	4	10-11
Introduction to Manufacturing Processes / Engineering Drawing and Graphics	ME1P001/ CE1P001	0-0-3/ 1-0-3	2/3	3/4	11-12
Physics Laboratory/ Chemistry Laboratory	PH1P001/ CY1P001	0-0-3	2	3	13
Electrical Technology Laboratory / Introduction to Programing and Data Structures Laboratory	EE1P001/ CS1P001	0-0-3	2	3	14
Extra Academic Activity-1	ID1T001	0-0-3	1	3	
		Total	22/23+1	25/27 or 26+3	
SEMESTER - II					
Subject Name	Code	L-T-P	Credit	Contact Hour	Syllabus Page No.
Mathematics-2	MA1L002	3-1-0	4	4	14
Chemistry/ Physics	CY1L001/ PH1L001	3-1-0	4	4	5-6
English for Communication or Learning English / Mechanics	HS1L001 or HS 1L002/ ME1L001	3-0-2 or 3-1-0/ 3-1-0	4	5 or 4/ 4	6-9
Introduction to Programming and Data Structures/ Electrical Technology	CS1L001/ EE1L001	3-1-0	4	4	10-11
Engineering Drawing and Graphics / Introduction to Manufacturing Processes	CE1P001/ ME1P001	1-0-3/ 0-0-3	3/2	4/3	12-13
Chemistry Laboratory/ Physics Laboratory	CY1P001/ PH1P001	0-0-3	2	3	11-12
Electrical Technology Laboratory / Introduction to Programing and Data Structures Laboratory	EE1P001/ CS1P001	0-0-3	2	3	13
Extra Academic Activity -2	ID1T002	0-0-3	1	3	
		Total	23/22+1	27 or 26/ 25+3	

Syllabus for each course is given in the following pages.

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Syllabus for First Year Courses (Common to All Disciplines of Study)

SEMESTER - I

Subject Code: MA1L001	Subject Name: Mathematics-1	L-T-P: 3-1-0	Credit: 4
Pre-requisite(s): Nil			
<p>Calculus: Rolle's theorem, Lagranges theorem, Cauchy's mean value theorem (Taylor's and Maclaurin theorems with remainders), Indeterminate forms, Concavity and convexity of a curve, points of inflexion, maximum, minimum of a function, 2nd derivative test for max min, Asymptotes and curvature, Cartesian curve tracing, polar curve tracing.</p> <p>Calculus of Several Variables: Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, differentials, derivatives of composite and implicit functions, derivatives of higher order and their commutativity, Euler's theorem on homogeneous functions, harmonic functions, Taylor's expansion of functions of several variables, maxima and minima of functions of several variables, Lagrange's method of multipliers.</p> <p>Vector Calculus: Double and triple integrals, Scalar and vector fields, level surfaces, directional derivative, Gradient, Curl, Divergence, line and surface integrals, theorems of Green, Gauss and Stokes. Beta and Gamma functions.</p> <p>Ordinary Differential Equations: First order differential equations, exact, linear and Bernoulli's form, second order differential equations with constant coefficients, Euler's equations, particular integrals by: variation of parameters, undetermined coefficients, operator method, system of differential equations.</p>			
Text Books:			
1. Narayan S. and Mittal P. K. <i>Differential Calculus and Integral Calculus</i> , S. Chand & Company Ltd.			
2. Thomas G. B. and Finney R. L. <i>Calculus and Analytic Geometry</i> , Pearson			
3. Kreyszig E. <i>Advanced Engineering Mathematics</i> , John Wiley & Sons			
5. Simmons G. F. and Robertson J. S. <i>Differential Equations with applications and Historical notes</i> , Tata McGraw-Hill Publishing Company Limited, New Delhi, India			
Reference Books:			
1. Bartle R. G. and Sherbert D. R. <i>Introduction to Real Analysis</i> , Wiley India			
2. Jain R. K. and Iyengar S. R. K. <i>Advanced Engineering Mathematics</i> , Narosa			
3. Apostol T. M. <i>Calculus - Vol.2</i> , Wiley India			
4. Ross S. L. <i>Differential Equations</i> , Wiley India			
5. Coddington E. A. <i>An Introduction to Ordinary Differential Equations</i> , Prentice Hall			

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Subject Code: PH1L001	Subject Name: Physics	L-T-P: 3-1-0	Credit: 4
Pre-requisite(s): Nil			
<p>Classical Physics: Review of Newtonian mechanics, Lagrangian mechanics, constraints, principle of virtual work, D'Alembert's principle, Action Principle and Lagrange's equations, Velocity dependent potentials, Legendre Transformation and Hamiltonian equations, Central forces, Kepler's problem, Waves and Oscillations, Damped and Forced Oscillations, normal modes, Basics of Special Relativity, Galilean and Lorentz transformations, Time dilation and length contraction, relativistic kinematics and mass-energy equivalence. Electromagnetic Waves and Optics: Maxwell's equations, wave equation, plane electromagnetic waves, longitudinal and transverse waves, superposition, wave packets, two and three dimensional waves, energy- momentum, Poynting's theorem, electromagnetic boundary conditions, Laser, Young's experiment, interferometers, diffraction, Fraunhofer diffraction (single slit), dispersion. Wave Mechanics: Failure of classical physics, qualitative review of relevant experiments, de Broglie waves, uncertainty principle, wave function and Schrodinger equation, probability interpretation, particle on a chain, potential barrier and quantum tunneling, potential well, Harmonic oscillator, operator algebra, Hydrogen atom and angular momentum algebra.</p> <p>Text/ Reference Books:</p> <ol style="list-style-type: none"> 1. Crawford F.S. <i>Waves, Vol. 3, Berkely Physics Series.</i> 2. Goldstein, <i>Classical Mechanics</i>, Pole and Safko, Pearson Education Inc. 3. Saleh and Teich. <i>Fundamentals of Photonics</i>, Wiley-Interscience. 4. Ghatak A. <i>Optics</i>, McGraw-Hill. 5. Griffiths D.J. <i>Introduction to Quantum Mechanics</i>, Pearson Education Inc. 6. Pain H. J. <i>The Physics of Vibrations and Waves</i>, Wiley. 7. Resnick R. <i>Introduction to Special Relativity</i>, John Wiley (Asia). 8. Landau L. and Lifshitz E. <i>Mechanics</i>, Oxford 9. Zweibach B. <i>A First Course in String Theory</i>, Cambridge University Press 10. Hecht E. <i>Introduction to Optics</i>, Addison-Wesley. 11. Feynmann Lecture series on Physics. 12. Sakurai J. J. <i>Modern Quantum Mechanics</i>, Benjamin-Cummings. 			

Subject Code: CY1L001	Subject Name: Chemistry	L-T-P: 3-1-0	Credit: 4
Pre-requisite(s): Nil			
<p>Energetics & Kinetics: (a) Basic Concepts and Laws of Thermodynamics; Entropy; Engineering Devices: Efficiency & Conversion; Thermochemistry; Bioenergetics. (b) Basic</p>			

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Rate Laws; Multistep Reactions; Activation Energy. (c) Transport of Ions and Gases in biofluids and across biomembranes; Equilibrium: Proton Equilibrium (aqueous & non-aqueous) including Buffers. Phase Equilibrium. Redox & Electrochemistry: Basic Concepts & Laws; Battery (Automobile to Ni-Cd and beyond); Fuel Cells; Latimer, Frost, and Pourbaix diagram; Corrosion. Bonding Models & Properties: (a) In Molecules, Supramolecules, Metals and Metal Complexes; (b) Implications on electrical, magnetic, and optical properties, (c) Absorption and Emission Spectroscopy. Functional Materials - *Design & Application*: (a) Synthetic Polymers (carbon framework, silicon framework, fluorinated polymer), Bio & biodegradable polymers. (b) Surfactants. (c) Nanostructures, Soft materials and Thin Films. (b) Emerging applications in Energy harvesting, Memory Storage and Micro-fabrication. Industrial & Bio-inspired Chemistry: (a) Case studies on Industrial organics with emphasis to Drugs (b) Oxidation, Reduction, Catalytic hydrogenation and Electron transfer. Molecules in Daily Life: A short tour on molecules behind taste, smell, pain, colour and sex.

Text/Reference Books:

1. Brown L. and Holme, T. *Chemistry for Engineering Students*, Thomson Brooks.
2. Atkins P. and Paula J. D. *Atkins' Physical Chemistry*, Oxford.
3. Shriver, D. F. and Atkins, P. W. *Atkins' Inorganic Chemistry*, Oxford.
4. Morrison R. T. and Boyd R. N. *Organic Chemistry*, Prentice Hall.
5. Steed J. W. and Atwood J. L. *Supramolecular Chemistry*, John-Wiley.
6. Caruther W. *Reagents in Organic Chemistry*, Cambridge University Press.
7. Wiseman P. *An Introduction to Industrial Organic Chemistry*, Applied Science.
8. Hall N. *The New Chemistry*, Cambridge University Press.
9. Atkins P. *Atkins' Molecules* Cambridge University Press.
10. Cengel Y. A. and Boles M. A. *Thermodynamics-An Engineering Approach*, Tata McGraw-Hill

Subject Code: ME1L001	Subject Name: Mechanics	L-T-P: 3-1-0	Credit: 4
Pre-requisite(s): Nil			
<p>Force systems: Moment of a force about a point and about an axis; couple moment; reduction of a force system to a force and a couple. Equilibrium: Free body diagram; equations of equilibrium; problems in two and three dimensions; plane frames and trusses. Friction: Laws of Coulomb friction, problems involving large and small contact surfaces; square threaded screws; belt friction; rolling resistance. Kinematics and Kinetics of particles: Particle dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables; central force motion. Properties of areas: Moments of inertia and product of inertia of areas, polar moment of inertia, principal axes and principal moments of inertia. Concept of stress and strain: Normal stress, shear stress, state of stress at a point, ultimate strength, allowable stress, factor of safety; normal strain, shear strain, Hooke's law, Poisson's ratio, generalized Hooke's law; analysis of axially loaded members. Torsion: Torsion of cylindrical bars, torsional stress, modulus of rigidity and deformation. Flexural loading: Shear and moment in beams; load, shear and moment relationship; shear and moment diagrams; flexure formula; shear stress in beams;</p>			

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differential equation of the elastic curve, deflection of beams. Transformation of stress and strain: Transformation of stress and strain, principal stresses, principal strains, Mohr's circle for stress and strain. Combined loading: Axial and torsional; axial and bending; axial, torsional and bending. Column: Buckling of slender columns, Euler buckling load for different end conditions.

Text/Reference Books:

1. Vector Mechanics for Engineers: *Statics and Dynamics* - Ferdinand P. Beer, E. Russell Johnston, Jr. (TMH)
2. Engineering Mechanics: *Statics and Dynamics* - I.H. Shames (Pearson)
3. Engineering Mechanics - S. Timoshenko, D. H. Young (TMH)
4. Mechanics of Materials - Ferdinand Beer, E. Russell Johnston, Jr., J. DeWolf (TMH)
5. Elements of Strength of Materials - S. Timoshenko, D. H. Young (East West Press)
6. Mechanics of Materials - James M. Gere, Barry J. Goodno (CL Engg)
7. Engineering Mechanics - Stephan Timoshenko, D. Young (TMH)
8. Strength of Materials (Part 1) - S P Timoshenko (CBS)

Subject Code: HS1L001	Subject Name: English for Communication	L-T-P: 3-1-0	Credit: 4
Pre-requisite(s): Nil			
<p>English for Communication is an amalgamation of Literature, Language and Communication. The Literature component of the course comprises of Prose and Poetry.</p> <p>Poetry: A selection of poetry pieces spanning from 16th century to the Post-Modern Period in English, American and Indian Literature are chosen to introduce to the students to the different poets from different ages and countries and also to acquaint them with the various poetic forms like Sonnet, Ballad, Elegy, Didactic, Dramatic, Nature, Lyric, Romantic, etc. The list is an indicative one. 16th century- 17th century- Geoffrey Chaucer, William Shakespeare, Edmund Spenser, Ben Johnson, Thomas Wyatt. 17th century- 18th century- John Milton, John Donne, George Herbert, John Dryden, Oliver Goldsmith. 18th century- 19th century- Alexander Pope, Thomas Gray, Robert Burns, William Blake, William Wordsworth, Samuel Taylor Coleridge, Lord Byron, P.B. Shelley, John Keats, Robert Bridges, Robert Southey, Samuel Johnson. 19th century- 20th century- Alfred Tennyson, Robert Browning, Walter de la Mare, Thomas Hardy, A.E. Housman, Rudyard Kipling, D.H. Lawrence, Wilfred Owen, D.G. Rossetti, Christina Rossetti, Emily Dickinson, Gerald Manley Hopkins, Charlotte Bronte, Lewis Carroll, Edward Fitzgerald, Walt Whitman. 20th century- Present- Ted Hughes, Louis MacNeice, W.B. Yeats, Stephen Spender, W.H. Auden, Nissim Ezekiel, Sarojini Naidu, Jayanta Mahapatra, Robert Frost, Ezra Pound, E.E. Cummings, T.S. Eliot, Walt Whitman, A.K. Ramanujan, Kamala Das, Rabindranath Tagore, Jack Prelutsky, Chinua Achebe, Maya Angelou, Margaret Atwood, Leonard Cohen, Louise Erdrich, Leslie Marmon Silko.</p> <p>Prose: A selection of fictional and non-fictional prose pieces spanning from 17th century to the Post-Modern Period. Fiction and non-fictional pieces from English, American, Russian</p>			

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and Indian Literature are chosen to introduce the students to different writings from different ages and countries. The list is an inclusive one consisting of short stories, essays, excerpts, extracts from novels, biographies and memoirs, history, travel and other forms. 17th century-18th century: Charles Dickens, William Makepeace Thackeray, George Eliot, Thomas Hardy, Lewis Carroll, Arthur Conan Doyle, John Bunyan, Rudyard Kipling, H.G. Wells, R.L. Stevenson, Jane Austen, Emily Bronte, Charles Lamb, F.M. Dostoyevsky, Nikolai Gogol, Daniel Defoe, Jonathan Swift, Lewis Carroll; 19th century-20th century: Oscar Wilde, O Henry, H.H. Munro, Mark Twain, Somerset Maugham, Nathaniel Hawthorne, G.B. Shaw, G.K. Chesterton, Agatha Christie, Gerald Durrell, Will Durant, E.M. Forster, Aldous Huxley, Henry David Thoreau, Anton Chekov, Maxim Gorky, Leo Tolstoy, George Orwell, Rabindranath Tagore, M.K. Gandhi, J. Nehru, Virginia Woolf, Guy De Maupassant, Washington Irving, Margaret Fuller, Charles Darwin, Arthur Conan Doyle, F. Scott Fitzgerald, Ernest Hemingway, Edgar Allan Poe. 20th century-Present: J.M. Coetzee, R.K. Narayan, R.K. Laxman, A.P.J. Abdul Kalam, Khushwant Singh, Anita Desai, Yann Martel, Ken Kesey, Stephen King, Thomas King, Richard Wright, N Scott Momaday, Chetan Bhagat, J. Krishnamurthy, Virginia Woolf, Gerald Vizenor, Alice Walker, Chinua Achebe, Jeffrey Archer, Isaac Asimov, Roald Dahl, J.R.R. Tolkien, D.H. Lawrence, James Joyce, Orhan Pamuk, Salman Rushdie, Bertrand Russell, Ruskin Bond, A.G. Gardiner, John Steinbeck.

Communication:

Because communication is so important in business, businesses want and need people with good communication skills. Business communication is a blend of skills like writing and speaking well, displaying proper etiquettes and listening attentively.

Communications through technology greatly enhances one's ability to communicate effectively and articulately. For example, E-mails often result in a sender's language skills being placed in front of different people simultaneously; while audio and video will reveal the calibre of one's verbal and diplomatic strengths. The communication aspect of the English for Communication Course includes:

1. The Basics of Business Communication
2. Importance of Listening
3. Barriers in the Communication Process
4. Business Letters (Letter of Inquiry, Complaint, Cover Letter)
5. Resume Writing
6. Memo and Memo Reports
7. Report Writing
8. Fax and E Mail

English Laboratory:

Objective: The laboratory component included in the course provides an ideal platform for students to prepare themselves into confident and self-assured individuals. The Lab course is designed to inculcate confidence and clarity in presentation and expression of thought, views and ideas through practice and exercises. It constitutes six basic components to improve listening, reading and writing skill of the students.

Lessons:

1. Pronunciation (Basic sounds of English like Long/Short Vowels; All consonants)
2. Stress Intonation (Rising and Falling)
3. Speaking- Oral Presentations, Group Discussions, Story Telling, Role Plays

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4. Listening – Importance and Practice
5. Reading- Practice
6. Writing (Paragraph writing, good writing and bad writing with samples, Indianism), Grammar (Basic- Articles, Prepositions, Verbs, Common Errors, etc)

Text/Reference Books:

1. John Seely, *The Oxford Guide to Writing and Speaking*, OUP
2. Krishna Mohan and Meenakshi Raman, *Effective English Communication*, TMH
3. R.W.Lesikar and John.D. Pettit, *Business Communication: Theory and Application*, All India Traveller Bookseller
4. Francis Soundaraj, *Speaking and Writing for Effective Business Communication*, Macmillan.
5. Herta A. Murphy, et al., *Effective Business Communication*, Tata Mc-Graw Hill: New Delhi
6. Ronald B. Adler and George Rodman, *Understanding Human Communication*, Oxford University Press: New York

Subject Code: HS1L002	Subject Name: Learning English	L-T-P: 3-1-0	Credit: 4
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Pre-requisite(s): Nil

The Learning English Course is designed to improve the English Listening, Speaking, Reading and Speaking skills of students.

I. Prose

A selection of fictional and non-fictional prose pieces spanning from 17th century to the Post-Modern Period. Fiction and non-fictional pieces from English, American, Russian and Indian Literature are chosen to introduce the students to different writings from different ages and countries. The list is an inclusive one consisting of short stories, essays, excerpts, extracts from novels, biographies and memoirs, history, travel and other forms.

17th century- 18th century- Charles Dickens, William Makepeace Thackeray, George Eliot, Thomas Hardy, Lewis Carroll, Arthur Conan Doyle, John Bunyan, Rudyard Kipling, H.G. Wells, R.L. Stevenson, Jane Austen, Emily Bronte, Charles Lamb, F.M. Dostoyevsky, Nikolai Gogol, Daniel Dafoe, Jonathan Swift, Lewis Carroll.

19th century- 20th century- Oscar Wilde, O Henry, H.H. Munro, Mark Twain, Somerset Maughaum, Nathaniel Hawthorne, G.B. Shaw, G.K. Chesterton, Agatha Christie, Gerald Durrell, Will Durant, E.M. Forster, Aldous Huxley, Henry David Thoreau, Anton Chekov, Maxim Gorky, Leo Tolstoy, George Orwell, Rabindranath Tagore, M.K. Gandhi, J. Nehru, Virginia Woolf, Guy De Maupassant, Washington Irving, Margaret Fuller, Charles Darwin, Arthur Conan Doyle, F. Scott Fitzgerald, Ernest Hemingway, Edgar Allan Poe.

20th century- Present- J.M. Coetzee, R.K. Narayan, R.K. Laxman, A.P.J. Abdul Kalam, Khushwant Singh, Anita Desai, Yann Martel, Ken Kesey, Stephen King, Thomas King, Richard Wright, N Scott Momaday, Chetan Bhagat, J. Krishnamurthy, Virginia Woolf, Gerald Vizenor, Alice Walker, Chinua Achebe, Jeffrey Archer, Issac Asimov, Roald Dahl, J.R.R. Tolkien, D.H. Lawrence, James Joyce, Oran Pamuk, Salman Rushdie, Bertrand Russell, Ruskin Bond, A.G. Gardiner, John Steinbeck.

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- II. Writing- Paragraph, Essay, Précis, Dictation, Comprehension, Letter Writing
 III. English Tutorial- Practice Listening and Speaking English
 IV. English Practice- Grammar Assignments and Workbook (Everyday English Level I/II)

Text/Reference Books:

1. John Seely, *The Oxford Guide to Writing and Speaking*, OUP
2. Krishna Mohan and Meenakshi Raman, *Effective English Communication*, TMH
3. R.W.Lesikar and John.D. Pettit, *Business Communication: Theory and Application*, All India Traveller Bookseller
4. Francis Soundaraj, *Speaking and Writing for Effective Business Communication*, Macmillan.
5. Herta A. Murphy, et al., *Effective Business Communication*, Tata Mc-Graw Hill: New Delhi
6. Ronald B. Adler and George Rodman, *Understanding Human Communication*, Oxford University Press: New York

Subject Code: EE1L001	Subject Name: Electrical Technology	L-T-P: 3-1-0	Credit: 4
Pre-requisite(s): Nil			
<p>Introduction: Sources of energy; General structure of electrical power systems, Power transmission and distribution via overhead lines and underground cables, Steam, Hydel, and Nuclear power generation; DC Networks: Kirchhoff's laws, node voltage and mesh current methods, Delta-star and star-delta conversion, Superposition principle, Thevenin's, Norton's theorems and Maximum power transfer theorem; Single phase AC Circuits: Single phase EMF generation, average and effective values of sinusoids, solution of R,L,C series circuits, the j operator, complex representation of impedances, phasor diagram, power factor, power in complex notation, solution of parallel and series - parallel circuits; Three phase AC Circuits: Three phase EMF generation, delta and Y - connections, line and phase quantities, solution of three phase circuits, balanced supply voltage and balanced load, phasor diagram, measurement of power in three phase circuits, Three phase four wire circuits; Magnetic Circuits: Ampere's circuital law, B - H curve, solution of magnetic circuits, hysteresis and eddy current losses; Transformers: Construction, EMF equation, ratings, phasor diagram on no load and full load, equivalent circuit, regulation and efficiency calculations, open and short circuit tests, auto-transformers; DC Machines: Construction, EMF and Torque equations, Characteristics of DC generators and motors, speed control of DC motors and DC motor starters; Electrical Measuring Instruments: DC PMMC instruments, shunt and multipliers, multimeters, Moving iron ammeters and voltmeters, dynamometer, wattmeter, AC watt-hour meter, extension of instrument ranges.</p>			

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Text/Reference Books:

1. E. Hughes, *“Electrical Technology,”* Pearson Education, 2010.
2. V. Del Toro, *“Electrical Engg Fundamentals,”* PHI Learning, 2009.
3. I. J. Nagrath and D. P. Kothari, *‘Basic Electrical Engineering’* TATA Mc Graw Hill Education, 2009.
4. D. A. Bell, *“Electric Circuits,”* 7th Ed., Oxford Higher Education, 2009.

Subject Code: CS1L001	Name: Introduction to Programming and Data Structure	L-T-P: 3-1-0	Credit: 4
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Pre-requisite(s): Nil

Digital computer fundamentals, concepts of algorithms and introduction to programming – examples; Constants and variables – data types, operators and expressions - type conversions, types of expressions; Assignment statements, input-output statements - concepts of data formats; Control statements: branching – if-else statements; iteration – while, do-while, for statements. nested control structures, switch, break and continue statements; Functions and recursion – examples; concepts of parameter passing by values and by reference; Arrays – single and multidimensional, examples – searching and sorting; Introduction to pointers, character strings and arrays, pointers and arrays; Structures, linked lists, dynamic allocation, stacks and queues, binary trees and tree traversals; Data files – creating, opening, closing and operating data files; (The programming language C to be used as the basis language).

Text Books/ Reference Books:

1. B. Gottfried, *“Schaum’s Programming with C,”* Tata McGraw-Hill.
2. E. Balaguruswamy, *“Programming in ANSI C,”* Tata McGraw-Hill.
3. Y. Kanetkar, *“Let us C,”* BPB Publications.
4. S. Lipschutz, *“Data Structures, Schaum’s Outlines Series,”* Tata McGraw-Hill.
5. Brian W. Kernighan and Dennis M. Ritchie, *“The C Programming Language,”* Prentice Hall of India.
6. Ellis Horowitz, Satraj Sahni and Susan Anderson-Freed, *“Fundamentals of Data Structures in C,”* W. H. Freeman and Company.

Subject Code: ME1P001	Name: Introduction to Manufacturing Processes	L-T-P: 0-0-3	Credit: 2
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Pre-requisite(s): Nil

Machining:

- Introducing to various machine tools and demonstration on machining
- Making a steel pin as per drawing by machining in centre lathe

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- External screw thread on lathe
- Making a cast iron Vee block by shaping
- Making a regular polygon prism (MS)/ hexagon by milling machine
- Slot fitting by milling machine
- Study of machining in machining in machining centre (CNC)
- Study of Electro discharge machining (EDM)

Foundry Practice:

- Orientation, demonstration and practice on metal casting
- Practicing sand moulding using split and uneven parting line pattern
- Practice on CO2 moulding and machine moulding
- Mechanised sand preparation and melting practice

Welding Practice:

- Practice on electric arc welding
- Practice on oxy-acetylene gas welding
- Introduction and demonstration on submerged arc welding

Metal Forming:

Demonstration of deep drawing and other forming process

Text/Reference Books:

1. Chapman W.A.J., *Workshop Technology - Part I*, CBS Publishers.
2. Chapman W.A.J., *Workshop Technology - Part II*, CBS Publishers.
3. Hajra Choudhury S.K., *Elements of workshop Technology Vol. I*, Media Promoters.
4. Hajra Choudhury S.K., *Elements of workshop Technology Vol. II*, Media Promoters.

Subject Code: CE1P001	Subject Name: Engineering Drawing and Graphics	L-T-P: 1-0-3	Credit: 3
Pre-requisite(s): Nil			
Introduction to IS code of drawing; Conics and Engineering Curves – ellipse, parabola, hyperbola, cycloid, trochoid, involute; Projection of lines – traces, true length; Projection of planes and solids; sold objects – cube, prism, pyramid, cylinder, cone and sphere; Projection on Auxiliary planes; Isometric projection, isometric scale; Section of solids – true shape of section; Introduction to CAD tools – basics; Introduction of Development and Intersection of surfaces.			
Text/Reference Books: Bhatt N.D. <i>Elementary Engineering Drawing</i> , Charotar Publishing House. Gill P.S. <i>Engineering Drawing & Engg. Graphics</i> , S. K. Kataria & Sons. Lakshminarayan L.V. and Vaish R.S. <i>Engineering Graphics</i> , Jain Brothers.			

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Subject Code: PH1P001	Subject Name: Physics Laboratory	L-T-P: 0-0-3	Credit: 2
Pre-Requisite(s): Nil			
<p>To determine the damping constant of the pendulum for different eddy damping current. To verify Malus's Law of polarization of light. To determine the wave length of the prominent lines of mercury source by a plane transmission diffraction grating and to calculate the resolving power and dispersive power of the grating. To study the intensity distribution of Fraunhofer diffraction pattern by a single slit and measure the width of the slit for a given wavelength of laser light. To determine the wavelength of the given source using the Michelson interferometer. To determine the wave length of the given source using Fresnel's biprism. To find out the resonance and beat time period of the coupled pendulum and find out the spring constant. To study the interference pattern and determine the radius of curvature of the plano convex lens using Newton's rings apparatus.</p>			
<p>Text/Reference Books: 1. Ghatak A. <i>Optics</i>, McGraw-Hill. 2. Pain H. J. <i>The Physics of Vibrations and Waves</i>, Wiley.</p>			

Subject Code: CY1P001	Subject Name: Chemistry Laboratory	L-T-P: 0-0-3	Credit: 2
Prerequisite(s): Nil			
<p>Experiment-1: Determination of the surface tension and parachor of a homologous series. Experiment -2: Measurement of the coefficient of viscosity of ethanol & ethanol -water system. Experiment -3: Studies on acid-base conductometric titration. Experiment- 4: Studies on PH metric titration of strong base with strong acid. Experiment -5: Estimation of sulphate ion in tap water by nepheloturbidimetric analysis. Experiment - 6: Spectrophotometric determination of acid dissociation constant (pka) of methyl red (MR) an acid base indicator. Experiment -7: Determination of solubility and solubility product of a sparingly soluble salt at room temperature by conductometric method. Experiment- 8: Potentiometric titration of a given sodium carbonate solution with aqueous hydrochloric acid solution. Experiment -9: kinetics of ester hydrolysis. Experiment -10: Detection of functional groups in an organic compound for solid sample. Experiment-11: Detection of functional groups in an organic compound for liquid sample. Experiment -12: Thin layer chromatography (TLC).</p>			

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Text/Reference Books:

1. Nad, A. K.; Mahapatra, B. and Ghoshal A. *An advanced course in practical chemistry*, New Central Book Agency (P) Ltd.
2. Elias A. J. *A collection of general chemistry experiments*, University Press.
3. Maity S. and Ghosh N. *Physical Chemistry Practical*, New Central Book Agency (P) Ltd.

Subject Code: EE1P001	Subject Name: Electrical Technology Laboratory	L-T-P: 0- 0-3	Credits: 2
Prerequisite(s): Electrical Technology			
Experiments as per the topics in the syllabus for the course `Electrical Technology` (EE1L001) will be conducted in the laboratory class.			
Text Books:			
<ol style="list-style-type: none"> 1. E. Hughes, "<i>Electrical Technology</i>," Pearson Education, 2010. 2. V. Del Toro, "<i>Electrical Engg Fundamentals</i>," PHI Learning, 2009. 			
Reference Books:			
<ol style="list-style-type: none"> 1. I. J. Nagrath and D. P. Kothari, '<i>Basic Electrical Engineering</i>' TATA McGraw Hill Education, 2009. 2. D. A. Bell, "<i>Electric Circuits</i>," 7th Ed., Oxford Higher Education, 2009. 			

Subject Code: CS1P001	Subject Name: Introduction to Programming and Data Structures Laboratory	L-T-P: 0-0-3	Credit: 2
Prerequisite(s): Introduction to Programing and Data Structures			
Familiarization of a computer and the environment; Execution of sample programs related to Expression evaluation, Conditionals and branching, Iteration, Functions, Recursion, Tail-recursion, Arrays, String manipulation, Structures, Linked lists, Doubly-linked lists and Binary Trees. Execution of programs involving abstract data types like Stacks and Queues.			

Semester-II

Subject Code: MA1L002	Subject Name: Mathematics- II	L-T-P: 3- 1-0	Credit: 4
Pre-requisite(s): Nil			
<i>Linear Algebra:</i> Vector spaces, subspaces, span, Linear dependence, independence of vectors, basis, dimension, linear transformations, range, kernel, rank, nullity of linear			

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transformation, space of all linear transformations, Operator equations, matrix associated with a linear map, linear map associated with a matrix, elementary row operations, solution of algebraic equations, consistency conditions. Matrix inversion by row operations, Eigenvalues and eigenvectors, Hermitian and skew Hermitian matrices, orthogonal and unitary matrices, application to reduction of quadrics.

Complex Analysis: Limit, continuity, differentiability and analyticity of functions Cauchy-Riemann equations (cartesian and polar), Harmonic functions, Elementary complex functions, Line integrals, upper bounds for moduli of contour integrals, Cauchy's integral theorem, Cauchy's integral formula, derivatives of analytic functions, Power series, Taylor's series, Laurent's series, Zeros and singularities, Residue theorem, evaluation of improper integrals by residue theorem.

Text books/ Reference Books:

1. Strang G. *Linear Algebra and its applications*, Cengage Learning
2. Churchill R.V. and Brown J.W. *Complex Variables and Applications*, Mc-Graw Hill
3. Kreyszig E. *Advanced Engineering Mathematics*, John Wiley & Sons
4. R. K. and Iyengar S. R. K. *Advanced Engineering Mathematics*, Narosa
5. Krishnamurthy V., Mainra V. P. and Arora J.L. *An Introduction to Linear Algebra*, Affiliated East-West Press Pvt Ltd New Delhi
6. Axler S. *Linear Algebra Done Right*, UTM, Springer
7. Poole D. *Linear Algebra: A Modern Introduction*, Brooks/Cole

All other courses are same as Semester-I Courses.

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B. Tech and Dual Degree (3rd Semester – 6th Semester Courses)

Mechanical Engineering (All Specializations – Manufacturing Engineering, Mechanical System Design and Thermal Science & Engineering)

SEMESTER - III					
Subject Name	Code	L-T-P	Credit	Contact Hour	Syllabus Page No.
Theory of Machines - I	ME2L001	3-1-0	4	4	18
Basic Electronics	EC2L005	3-1-0	4	4	18-19
Transform Calculus (Mathematics - V)	MA2L005	3-0-0	3	3	19
Introduction to Material Science and Engineering	ID2L001	2-0-0	2	2	19-20
Introduction to Bio Science and Technology	ID2L002	2-0-0	2	2	20-21
Fluid Mechanics	ME2L002	3-1-0	4	4	21
Workshop Processes	ME2P001	0-0-3	2	3	21
Basic Electronics Laboratory	EC2P005	0-0-3	2	3	22
Fluid Mechanics Laboratory	ME2P002	0-0-3	2	3	22
Seminar	ME2S001	0-0-0	2	0	
		Total	28	29	
SEMESTER - IV					
Thermodynamics	ME2L003	3-0-0	3	3	22
Partial Differential Equations (Mathematics - IV)	MA2L004	3-1-0	4	4	23
Environmental Science, Technology and Management	ID3L003	2-0-0	2	2	23
Breadth-1		3-0-0	3	3	
Mechanics of Solids	ME2L004	3-1-0	4	4	24
Theory of Machines - II	ME2L005	3-1-0	4	4	24-25
Lateral Theory - 1		3-0/1-0	3/4	3/4	
Machines & Mechanisms Laboratory	ME2P003	0-0-3	2	3	25
Materials Testing Laboratory	ME2P004	0-0-3	2	3	25
		Total	27/28	29/30	
SEMESTER - V					
Lateral Theory-2	ME3LXXX	3-0/1-0	3/4	3/4	
Heat Transfer	ME3L001	3-1-0	4	4	25-26
Design of Machine Elements	ME3L002	3-0-0	3	3	26
Casting, Welding and Forming (CWF)	ME3L003	3-0-0	3	3	26-27
Systems & Control	ME3L004	3-0-0	3	3	27
Thermo-Fluid Lab - 1	ME3P001	0-0-3	2	3	27-28
CWF Laboratory	ME3P002	0-0-3	2	3	28
Machine Design Practice	ME3P003	0-0-3	2	3	28
		Total	22/23	24/25	
SEMESTER - VI					

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Lateral Theory-3	ME3LXXX	3-0/1-0	3/4	3/4	
IC Engines	ME3L005	3-0-0	3	3	28-29
Refrigeration & Air-Conditioning	ME3L006	3-0-0	3	3	29
Elective-1	ME3LXXX	3-0-0	3	3	
Machine Tool & Machining (MTM)	ME3L007	3-0-0	3	3	29
Power Plant Engineering	ME3L008	3-0-0	3	3	30
Thermo-Fluid Lab - 2	ME3P004	0-0-3	2	3	30
MTM Laboratory	ME3P005	0-0-3	2	3	30
		Total	22/23	24/25	
INDUSTRIAL SUMMER TRAINING					

List of Lateral Subjects (I, II and III) for Other Schools

Subject Name	Code	L-T-P	Credit	Contact Hour	Page No.
Lateral - I					
Elements of Mechanical Engineering	ME2L007	3-1-0	4	4	31
Lateral - II (Anyone will be offered)					
Applied Thermodynamics	ME3L004	3-0-0	3	3	31-32
Introduction to CAD/CAM	ME3L005	3-0-0	3	3	32
Lateral - III (Anyone will be offered)					
Introduction to Robotics	ME3L006	3-0-0	3	3	32-33
Industrial Engineering & Management	ME3L007	3-0-0	3	3	33

List of Elective Subjects

Elective - I					
Subject Name	Code	L-T-P	Credit	Contact Hour	Page No.
Operations Research	ME3L012	3-0-0	3	3	33-34
Computational Fluid Dynamics	ME3L013	3-0-0	3	3	34
Robotics	ME3L014	3-0-0	3	3	34-35
Intermediate Fluid Mechanics	ME3L015	3-0-0	3	3	35

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Semester-III

Subject Code: ME2L001	Name: Theory of Machines - I	L-T-P: 3-1-0	Credit: 4
Pre-Requisite: None			
<p>Introduction: - Analysis & Synthesis, Terminology, Definition, Types of Mechanism (Planner, Spatial), Mobility, Classification of Mechanisms, Inversions Movability Criteria. Position Analysis - Graphical Method. Analytical Method. Velocity Analysis- Graphical Method, Analytical Method. Instant Centers of Velocity. Acceleration Analysis- Graphical Method, Analytical Method.</p> <p>Design of Mechanism: - Cam Design: - Introduction, classification of cams & followers. Displacement diagram, Graphical layout of cam profiles, standard cam motions. Gears - Terminology and definition, fundamental law of gearing, Involute properties, interference and Undercutting, Content Ratio, Involumetry, Types of Gears. Gear Train - Simple and Compound Gear Train, Epicyclic Gear Train, Analysis of Planetary Gear by formula and tabular Method, Differentials. Synthesis of linkages- Type, Number and Dimensional Synthesis Function Generation, Path Generation, Two, Three and Four Position Synthesis, Precision Positions, Structural Error, Chebyshev Spacing, Frudenstein's Equation.</p> <p>Dynamics of Machines: - Static Force - Introduction, Analysis with & without formation, Methodology of Virtual Work. Dynamic Force Analysis - Introduction, Inertia Forces & D. Alembert's Principle, Principle of Superposition, Shaking forces & moments, Complex Algebra Approach. Dynamics of reciprocating Engines - Engine types, Indicator Diagrams, Dynamic Analysis, Equivalent Masses, Inertia Forces, Crankshaft torques, Engine Shaking Forces. Fly Wheel -Dynamic Theory, Integration Techniques, Multicylinder Engine Torque Summation.</p> <p>Text/ Reference Books:</p> <ol style="list-style-type: none"> 1. R. L. Norton, Design of Machinery, 2nd Ed., McGraw-Hill, 1999 2. David H. Myszka, Machines and Mechanisms: Applied Kinematic Analysis, 4e Ed., Prentice Hall, 2011 3. Thomas Bevan, Theory of Machines, CBS Publishers & Distributors, Delhi. 4. Shigley J. E. and Uicker J. J., Theory of Machines and Mechanisms, McGraw Hill, Inc. 5. Ghosh Amitabh and Malik A.K., Theory of Machines and Mechanism, East-West Press. 6. Wilson, C E Sandler, J P Kinematics and Dynamics of Machinery, Pearson Education. 			
Subject Code: EC2L005	Name: Basic Electronics	L-T-P: 3-1-0	Credit: 4
Pre-Requisite: None			
<p>Semiconductor devices: Diode, BJT, MOSFET, their structures and principle of operations; Amplifiers: Functionality, specifications (voltage gain, current gain, input resistance, output resistance, dynamic range, bandwidth, linearity, power efficiency etc.), effect of cascading, various applications and typical circuits; Filters: Low pass, high pass, band pass and band stop filters, single and higher order passive filter topologies (RC and LC); Feedback: Basic concept of negative and positive feedback, application of negative feedback in amplifiers, effect on gain, bandwidth, input resistance, output resistance and desensitivity to parameter variations; Oscillators: Barkhausen criterion, sinusoidal and non-sinusoidal oscillators, applications and typical circuits; Operational amplifier: Differential mode of operation, common mode rejection, typical op-amp specifications, inverting amplifier, non-inverting amplifier, integrator, differentiator, summing amplifier etc., concept of active filters; Power</p>			

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electronics: Half wave and full wave rectification, filtering, regulation with zener diode and linear regulators, switched mode power supply; Digital electronics: Review of Boolean algebra and signed number representation schemes in binary, implementation of Boolean functions using various logic gates, concept of combinatorial and sequential circuits, registers and counters from functional viewpoint, concept of programmable processors and microcontrollers.

Text/ Reference Books:

1. A. Malvino and D. J Bates "Electronic Principles," Tata McGraw - Hill Education, 2006.
2. D. A. Neamen, "Electronic Circuits," Tata McGraw - Hill Education, 2006.
3. Malvino and Brown, "Digital Computer Electronics," Tata McGraw - Hill Education, 2001.
4. Samuel C. Lee, "Digital Circuits and Logic Design," PHI Learning, 2009.
5. R. A. Gayakwad, "Op-Amps and Linear Integrated Circuits," PHI Learning, 2009.

Subject Code: MA2L005	Name: Transform Calculus (Mathematics - V)	L-T-P: 3-0-0	Credit: 3
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Pre-Requisite: None

Laplace Transform: Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties, Laplace Transform of derivatives and integrals, unit step functions, Dirac delta-function, error function. Differentiation and integration of transforms, convolution theorem, inversion, periodic functions. Evaluation of integrals by Laplace Transform. Solution of initial and boundary value problems.

Fourier Series: Periodic functions, Fourier series representation of a function, half range series, sine and cosine series, Fourier integral formula, Parseval's identity.

Fourier Transform: Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties. Self-reciprocity of Fourier Transform, convolution theorem.

Other Transforms: Brief Introduction of Z-Transform, Mellin transform and Wavelet Transform, Hilbert Transform, Radon Transform.

Text/ Reference Books:

1. Jain R. K. and Iyengar S. R. K. Advanced Engineering Mathematics, Narosa
2. Dyke P. P. G. Introduction to Laplace Transform and Fourier Series, Springer
3. Watson E. J. Laplace Transforms and Applications
4. Pinkus A. & Zafrany S. Fourier Series and Integral Transforms, Cambridge University Press
5. Rao K. S. Introduction to Partial Differential Equations, Prentice Hall of India Private Ltd

Subject Code: ID2L001	Introduction to Material Science and Engineering	L-T-P: 2-0-0	Credit: 2
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Pre-Requisite: None

Atomic structure and Bonding: Electrons in atoms, Bonding forces and energies, Ionic bonding, Covalent Bonding, Metallic Bonding, Secondary bonding.

Structure of Crystalline Solids: Crystalline and noncrystalline materials, Crystal structures in metals and ceramics, Miller indices

Imperfections in Solids: Point defects, Line defects and dislocations, Interfacial defects, Bulk or volume defects, significance of defects in materials

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Diffusion in materials: Diffusion mechanisms, Steady and non-steady state diffusion, Factors that influence diffusion

Phase Diagrams: Definitions and basic concepts, Types of phase transformations, Gibbs Phase Rule, Interpretation of phase diagrams

Mechanical Properties of Materials: Elastic deformation, Plastic deformation, Interpretation of tensile stress-strain curves, Measurement of hardness in materials

Electrical Properties of Materials: Electrical conduction, Semiconductivity, Dielectric Behaviour, Ferroelectric and Piezoelectric Behaviour

Thermal Properties: Heat capacity, Thermal expansion, Thermal conductivity, Thermal stresses

Magnetic Properties: Basic concepts, Diamagnetism, Paramagnetism, Ferromagnetism, Antiferromagnetism, Ferrimagnetism, Influence of temperature, Domains and Hysteresis

Optical Properties: Interaction of light with solids, Optical properties of metals and non-metals.

Text/ Reference Books:

1. Materials Science and Engineering, William D. Callister, Jr. Wiley India (P) Ltd.
2. Introduction to Physical Metallurgy, Sidney H. Avner, Tata McGraw-Hill.

Subject Code: ID2L002	Subject Name: An Introduction to Bioscience & Technology	L-T-P: 2-0-0	Credit: 2
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Pre-Requisite: None

Cell: The Unit of Life: The concept of cell in the perspective of a whole living body; Concept of cell, tissue system, organ and whole organism. Brief overview of plant and animal cell.

Genes are DNA & Bioinformatics: DNA is the genetic material; Structural aspects– components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson and Crick model). Mutations change the sequence of DNA, a gene codes for a single polypeptide, recombination occurs by physical exchange DNA, genetic code is triplet. NCBI, protein primary sequence analysis, DNA sequence analysis, sequence alignment, BLAST, multiple sequence alignment; CLUSTALW.

Expression of genetic information: Central dogma: The Relationship between genes and protein, Visualization of protein structure using PyMol, The Central dogma; The basic processes of DNA replication, RNA Transcription and Protein translation; Protein function: Enzymes as a case study.

Mutation and Disease: Occurrence, kinds of Mutation, spontaneous & induced Mutation, Mutagens, detection of Mutation, Lethal Mutations, Biochemical Mutations, Phenotypic effects of Mutation, Molecular basis of Mutation, Significance & Practical applications of Mutation.

Immune system: An overview of immune system.

Genetic Engineering: Recombinant DNA technology and basic genetic engineering techniques; some case studies: Cholera Toxin, Bt toxins, GM food, transgenic plants.

Text/ Reference Books:

1. Nelson D. L. and Cox M. M. Lehninger Principles of Biochemistry, W. H. Freeman & Company.
2. Lodish H.; Berk A. and Kaiser C. A. Molecular Cell Biology & eBook, W. H. Freeman & Company.

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3. Voet and Voet. Biochemistry, Wiley.

Subject Code: ME2L002	Name: Fluid Mechanics	L-T-P: 3-1-0	Credit: 4
Pre-Requisite: None			
<p>Introduction: properties of fluids, concept of continuum, pressure and stresses; Fluid statics: pressure variation in a static fluid, force on submerged surfaces, stability of floating bodies; Integral relations for Control volume: Reynolds transport theorem – conservation of mass, linear and angular momentum & energy; Differential relations for fluid flow – Acceleration of fluid (Eulerian & Lagrangian), Differential equation for mass continuity, linear momentum & energy; Inviscid & Irrotational Flows: Euler equation, Bernoulli's equation and its applications; Dimensional Analysis & Similitude; Viscous Flows in Pipes: Laminar & Turbulent Pipe flow, friction factor, Moody diagram, hydraulic diameter, minor and major losses; Introduction to boundary layer.</p> <p>Text/ Reference Books:</p> <ol style="list-style-type: none"> 1. Fox R.W., and McDonald A.T., Introduction to Fluid Mechanics, John Wiley & Sons, Inc. 2. White F.M., Fluid Mechanics, Tata McGraw Hill Publishing Company Limited. 3. Cengel Y.A., and Cimbala J.M., Fluid Mechanics: Fundamentals and Applications, McGraw-Hill Science/Engineering/Math. 4. Young, Munson, Huebsch, Okiishi, Fundamentals of Fluid Mechanics, Wiley. 5. Som S.K. & Biswas G., Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Publishing Company Limited. 			
Subject Code: ME2P001	Name: Workshop Processes	L-T-P: 0-0-3	Credit: 2
Pre-Requisite: None			
<p>Turning: facing, drilling, boring, turning-straight, taper, eccentric, grooving, thread cutting, forming etc. in centre lathes.</p> <p>Milling: surfacing, making regular polygons and cutting gear teeth in milling machines.</p> <p>Hobbing: gear teeth generation in gear shaping machine and hobbing machine.</p> <p>CNC Machining: part programming and machining in CNC machining center setting and operation of EDM finishing by grinding Measurement of dimensions, forms and surface finish of machined products.</p> <p>Text/ Reference Books:</p> <ol style="list-style-type: none"> 1. Rao P.N., Manufacturing Technology, Tata McGraw – Hill. 2. Jain R.K., Production Technology, Khanna Publishers. 3. Lindberg, Process and materials of manufacturing, Prentice-Hall. 4. Heine R.W., Loper C.L., and Rosenthal P.C., Principles of Metal Castings, Tata McGraw – Hill. 			

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Subject Code: EC2P005	Subject Name: Basic Electronics Laboratory (for SMS, SIF)	L-T-P: 0-0-3	Credits: 2
Pre-Requisite: None			
Familiarization with electronic components; Familiarization and usage with oscilloscope, signal generator, multimeter; Frequency-response of R-C, C-R and R-L networks; Square-wave testing, V-I characteristics of PN junction diode and zener diode; Voltage Rectifiers; Common-Emitter amplifiers; Analog circuits using OP-AMP; logic gates.			
Text/ Reference Books:			
<ol style="list-style-type: none"> 1. A. Malvino and D. J Bates "Electronic Principles," Tata McGraw - Hill Education, 2006. 2. D. A. Neamen, "Electronic Circuits," Tata McGraw - Hill Education, 2006. 3. Malvino and Brown, "Digital Computer Electronics," Tata McGraw - Hill Education, 2001. 4. Samuel C. Lee, "Digital Circuits and Logic Design," PHI Learning, 2009. 5. R. A. Gayakwad, "Op-Amps and Linear Integrated Circuits," PHI Learning, 2009. 			
Subject Code: ME2P002	Name: Fluid Mechanics Lab	L-T-P:0-0-3	Credit: 2
Pre-Requisite: None			
Hydrostatic Pressure & Measurement of Pressure; Center of Pressure on a Submerged Plane Surface; Impact of a Jet of Water; Laminar & Turbulent Flow in Pipes; Minor & Major Losses in Pipe Flow; Measurement of Flow Rates; Pressure Distribution About a Circular Cylinder, Drag Force Determination; External Laminar Flows Over Immersed Bodies; Laminar & Turbulent Boundary Layer.			

Semester-IV

Subject Code: ME2L003	Name: Thermodynamics	L-T-P: 3-0-0	Credit: 3
Pre-Requisite: None			
Introduction, Thermodynamic equilibrium; Qasi-static process; Zeroth law and reference points in thermometry; Work and heat transfer; First law for a closed system; Steady flow energy equation; Second law: Kelvin-Planck and Clausius statements; Causes of irreversibility; Carnot's theorem; Absolute temperature scale; Inequality of Clausius; Entropy principle; Entropy transfer and entropy generation; Quality of energy; Energy principle; Guoy-Stodale theorem; Properties of a pure substance; p-v, p-T, T-s and h-s diagrams; Properties of gases and gas mixtures, Equations of state; Law of corresponding states; Maxwell's equations; Joule-Kelvin effect; Clausius-Clapeyron equation; Brayton cycle; Jet propulson; Turboprop, turbojet and ramjet engines.			
Text/ Reference Books:			
<ol style="list-style-type: none"> 1. Michael A.B., and Cengel Y.A., Thermodynamics: An Engineering Approach, Tata McGraw - Hill Education. 2. Van Wylen G.J., and Sonntag R.E., Fundamentals of Classical Thermodynamics, John Wiley & Sons Inc. 3. Nag P.K., Engineering Thermodynamics, Tata McGraw - Hill. 4. Kumar D.S., Thermal Science and Engineering, S. K. Kataria & Sons. 			

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Subject Code: MA2L004	Name: Partial Differential Equations	L-T-P: 3-1-0	Credit: 4
Pre-Requisite: None			
<p>Power series solution of ODE, Frobenius series, Bessel functions and Legendre polynomials. Introduction to partial differential equations, linear and quasi-linear equations of first order. Classification of integrals, Pfaffian differential equation in three variables. Lagrange's Method of solution and its geometrical interpretation, compatibility condition, Charpits method, special types of first order equations. Second order partial differential equations with constant and variable coefficients, classification and reduction of second order equation to canonical form., characteristics. Cauchy problem, Cauchy's, Neumann and Dirichlet problems. Fourier series solution of wave equation, vibrations of a string. Method of separation of variables to solve heat equation, Laplace equation, Diffusion equation. Integral transform method to solve second order partial differential equations.</p>			
Text/ Reference Books:			
<ol style="list-style-type: none"> 1. I N Sneddon: Elements of Partial Differential Equation: Dover Publication of 1957 books 2. Erwin Kreyszig: Advanced Engineering Mathematics (10th Edition): JOHN WILEY & SONS, 2011 3. Peter V O'Neil: Advanced Engineering Mathematics (7th Edition): Cengage Learning, 2011 			
Subject Code: ID3L003	Subject Name: Environmental Science, Technology and Management	L-T-P: 2-0-0	Credit: 2
Pre-Requisite: None			
<p>Module-I: Introduction to Environmental System (10-12 Lectures) Components of Earth System: Lithosphere, Cryosphere, Atmosphere, Hydrosphere, Biosphere and Outer space, Science of Weather and Climate systems and their variabilities, Energy, Water, Carbon and Nitrogen Cycles in the Atmosphere, Environmental Pollution (Air, Water, Noise, Soil and Marine), Natural Hazards, Climate Change and Global Warming, Green energy and adaptation to Climate change, Observations-modeling-prediction of environmental systems. Role of ocean on earth's climate system</p> <p>Module-II: Green and Sustainable Technology (6-8 Lectures) Pollution issues in Industries, Introduction to Green Technology, Emerging and sustainable practices in Electronics, Chemical, Petroleum and Mineral Processing Industries, 12 Principles of Green Chemistry and 12 Principles of Green Engineering.</p> <p>Module-III: Environmental Economics and Policies (8-10 Lectures) Components of Earth System: Sustainable development, economics of renewable and non-renewable natural resources, Green growth, Environmental valuation, accounting and audit, Carbon Trading, Command and control approach and market-based instruments for reducing pollutions, Environmental policies and acts (Air, Noise, Water, Forest, E-waste, Hazardous waste acts).</p>			
Text/ Reference Books:			

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Subject Code: ME2L004	Name: Mechanics of Solids	L-T-P: 3-1-0	Credit: 4
Pre-Requisite: None			
<p>Review of Elementary Mechanics of Materials, Methods of Analysis, Stress – Strain Relations, Failure and Limits on Design. Analysis of Stress and Strain: Definition of Stress at a point, Stress Notation, Symmetry of the stress Array on an Arbitrarily Oriented plane, Transformation of Stress, Principal Stresses, and Other Properties, Differential Equations of Motion of a Deformable Body, Deformation of a Deformable body, Strain Theory, Transformation of Strain, and Principal Strains, Small – Displacement Theory, Strain Measurements and Strain Rosettes. Theories of Failure or Yield Criteria: General Concepts. Applications of Energy Methods. Bending of Straight Beams, Shear Center for Thin – Wall Beam Cross Sections, Curved Beams, Axisymmetric Problems, Torsion and Elastic Stability. Introduction to Fatigue, Creep and Fracture.</p> <p>Text/ Reference Books:</p> <ol style="list-style-type: none"> 1. Boresi A.P., and Schmidt R.J., Advanced Mechanics of Solids, Willey. 2. Srinath L.S., Advanced Mechanics of Solids, Tata McGraw – Hill. 3. Timoshenko S.P., Strength of Materials - (Part 1 & 2), CBS Publishers. 4. Timoshenko S.P., and Goodier J.N., Theory of Elasticity, Tata McGraw – Hill. 5. Johnston E.R., Beer F.P., Dewolf J.T., and Mazurek D.F., Mechanics of Materials (In SI units) –Tata McGraw – Hill. 6. Hibbeler R.C., Mechanics of Materials (In SI units), Pearson Education. 7. Popov E.P., Engineering Mechanics of Solids, Prentice-Hall. 			
Subject Code: ME2L005	Name: Theory of Machines - II	L-T-P: 3-1-0	Credit: 4
Pre-Requisite: None			
<p>Kinematics of Particles: Representation of motion of particles in various coordinate systems, relative motion in translating frames, constrained motion; Kinetics of particles: Newtons second law, equations of motion for unconstrained and constrained motion, work-energy relation, conservation of energy, conservative and non-conservative forces, potential energy, impulse-momentum relation, angular momentum, conservation of momentum, d’Alemberts principle. Applications: central force motion, impact. Kinetics of a system of particles: Newtons second law, work-energy relation, impulse-momentum relations, conservation laws, steady and variable mass flow systems; Plane kinematics of rigid bodies: Kinematics of rigid bodies, instantaneous center of rotation, kinematics in rotating frames and relative motion; Plane kinetics of rigid bodies: Linear and angular momentum, equations of motion, work-energy relation, impulse-momentum relation, conservation laws; Introduction to spatial dynamics of rigid bodies: Kinematics in rotating frames and relative motion, angular momentum, kinetic energy, equations of motion, special cases of parallel-plane motion, and gyroscopic motion. Dynamics of Machinery: Balancing- Static unbalance, Dynamic unbalance, Dynamic balancing, Field balancing, Balancing of single cylinder and multicylinder Engines, analytical technique for balancing multicylinder reciprocating engines. Governors- Classification, Centrifugal and inertia governors, Terminology used in Governors- Height, equilibrium speed, Hunting, isochronism, stability, sensitiveness. Gyroscopes- Gyroscopic Action in Machines: Angular velocity and acceleration, gyroscopic torque and couple, gyroscopic effect on naval ships Vibration- Free Vibration of SDOF Systems: Basic concepts; undamped translational system; Rayleigh’s energy method; free vibration with viscous damping. Harmonically Excited</p>			

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Vibration: Equation of motion; undamped response; magnification factor; damped response; energy dissipation.

Text/ Reference Books:

1. Beer F.P., and Johnston Jr. E.R., Vector Mechanics for Engineers: Dynamics, McGraw-Hill Book Company Inc.
2. Kraige L.G., and Meriam J.L., Engineering Mechanics - Dynamics, Wiley.
3. Hibbeler R.C., Engineering Mechanics - Dynamics, New Jersey: Pearson Prentice Hall.
4. Norton R.L., Design of Machinery, McGraw-Hill.
5. Myszka D.H., Machines and Mechanisms: Applied Kinematic Analysis, Prentice Hall.
6. Bevan T., Theory of Machines, CBS Publishers & Distributors, Delhi.
7. Shigley J.E., and Uicker J.J., Theory of Machines and Mechanisms, McGraw Hill, Inc.
8. Ghosh A., and Malik A.K., Theory of Machines and Mechanism, East-West Press.
9. Wilson C.E., and Sandler J.P., Kinematics and Dynamics of Machinery, Pearson Education.

Subject Code: ME2P003	Name: Machines & Mechanisms Laboratory	L-T-P: 0-0-3	Credit: 2
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Pre-Requisite: None

Four Bar Link Mechanism, Single Stage Helical Gear, Oldham's Coupling, Single Stage Spur Gear with Intermediate gear, Differential Gear, Universal Joint-Single and Double joint, Epicyclic Gear with Three Gears, Reciprocating Engine Mechanism, Oscillating Cylinder Mechanism, Sun-Planet Annular gear, Three Stage Spur Gear, Whitworth Quick Return Mechanism, Scotch-Yoke Mechanism, Worm Gear, Single Stage Spur Gear(Parallel Axis), Bevel Gear(Single).

Subject Code: ME2P004	Name: Materials Testing Laboratory	L-T-P: 0-0-3	Credit: 2
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Pre-Requisite: None

Tests using UTM (Tensile test, Three point bend test, compression test etc.; Hardness tests; Impact test; Fatigue test (Rotary and Axial); Torsion test; Cupping test; Spring compression test; Stresses in pressure vessels; Introduction to Photoelasticity; Strain measurements using strain gauges.

Semester-V

Subject Code: ME3L001	Name: Heat Transfer	L-T-P: 3-1-0	Credit: 4
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Pre-Requisite: None

Modes of heat transfer, thermal conductivity, combined modes of heat transfer, concept of thermal contact resistance. Derivation of heat conduction equation, steady state one-dimensional heat conduction with and without generation of heat in simple geometries: plane wall, cylindrical and spherical walls, critical thickness of insulation, heat transfer from extended surfaces, 2D steady state heat conduction Unsteady conduction: lumped heat-capacity system, transient heat conduction in infinite and semi-infinite walls, concept of Heisler chart and Schmidt plot, heat conduction from a moving heat source. Forced convection: Derivation of energy equation, concept of thermal boundary layer and derivation of thermal boundary layer equation, flat plate in parallel flow (solution by energy integral method), cylinder in cross flow, internal flows: concept of thermally fully developed flow and its corollaries, fully developed pipe flow, fully developed channel flow with constant wall

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heat flux and viscous dissipation, turbulent flow in pipes, Reynolds analogy. Free convection: Vertical plate at constant temperature: derivation of governing equation, recognition of dimensionless terms, and solution by integral method, free convection in vertical channel. Condensation and Boiling: laminar film condensation over a vertical plate and horizontal circular tube. regimes of boiling heat transfer, correlations for heat flux in boiling. Heat exchangers: classification of heat exchangers, overall heat transfer coefficient, concept of fouling factor, LMTD and NTU methods of analysis for a double pipe heat exchanger, applications to multi-tube, multi-pass heat exchangers. Thermal radiation: Radiation properties, blackbody radiation, Planck's law, Stefan-Boltzman law, Kirchoff's law, radiation exchange between black surfaces, concept of view factor, radiation exchange between non-black surfaces, two-surface enclosure, three surface enclosure, concept of radiation shield.

Text/ Reference Books:

1. Incropera, Bergman and DeWitt, Fundamentals of Heat and Mass Transfer, John Wiley & Sons Inc.
2. Cengel Y., Heat Transfer: A Practical Approach, McGraw-Hill Professional.
3. Ozisik M.N., Heat Transfer: A Basic Approach, McGraw-Hill Companies.
4. Holman J.P., Heat Transfer, McGraw-Hill.
5. Bejan A., Convection Heat Transfer, Wiley.

Subject Code: ME3L002	Name: Design of Machine Elements	L-T-P: 3-0-0	Credit: 3
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Pre-Requisite: None

Introduction to Mechanical Engineering Design; Failure Preventions; Materials; Factor of Safety; Fits and Tolerances; Welding, Bonding, and the Design of Permanent Joints; Screws, Fasteners, and the Design of Non-Permanent Joints; Shafts; Clutch, Brakes, Couplings, and Flywheel; Mechanical Springs; Lubrication and Bearings; Gears - General; Flexible Mechanical Elements.

Text/ Reference Books:

1. Shigley J.E., Shigley's Mechanical Engineering Design, McGraw Hill.
2. Norton R.L., Machine Design 'An Integrated Approach', Pearson.
3. Spotts M.F., Design of Machine Elements, Pearson.
4. Bhandari V.B., Design of Machine Elements, McGraw Hill.
5. Khurmi R.S., and Gupta J.K., Machine Design, S Chand.
6. Lingaiah K., Machine Design Data Book, Tata McGraw - Hill.

Subject Code: ME3L003	Name: Casting, Welding and Forming (CWF)	L-T-P: 3-0-0	Credit: 3
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Pre-Requisite: None

Casting: Types of foundries, steps in making a casting; cast metals; types, materials and allowances of patterns; moulding processes and their characteristics; moulding materials; gating and risering; melting furnaces; casting defects. Welding: Welding processes; welding energy sources and their characteristics; fluxes and coatings; weldability and welding of various metals and alloys; metallurgical characteristics of welded joints; weld testing and inspection. Forming: Classification of metal forming processes; basic metal working concepts and plasticity; yield criterion; slip line fields; estimation of force and energy requirements;

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technology of bulk and sheet metal forming processes; precision forming processes; various features of different types of metal forming dies; principles of powder forming.

Text/ Reference Books:

1. Kalpakjin S, Manufacturing Engineering and Technology, Pearson Education.
2. Rao P.N., Manufacturing Technology, Tata McGraw – Hill.
3. Jain R.K., Production Technology, Khanna Publishers.
4. Lindberg, Process and materials of manufacturing, Pearson Education.
5. Heine R. W., Loper C. R. and Rosenthal P. C., Principles of Metal Castings, Tata McGraw – Hill.
6. Parmar R. S., Welding Process and Technology, Khanna Publishers.
7. Sharma P. C., A Textbook of Production Technology, S Chand.
8. Dalela S., and Shankar R., Production Engineering, Galgotia Publications Pvt. Ltd.

Subject Code: ME3L004	Name: Systems & Control	L-T-P: 3-0-0	Credit: 3
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Pre-Requisite: None

Introduction to Control Systems: Definition, Examples of control systems, Open loop and closed-loop control systems.

System Modeling: Signal flow graph, Block diagram, Transfer function, Poles and zeros, Block diagram and signal flow reduction techniques, Mathematical modeling of Mechanical, electrical and electromechanical systems, First and second order models.

Control System Types: Introduction, Linear approximation of nonlinear systems, Hydraulic systems, Pneumatic systems, Thermal systems

Time Response Analysis: Definitions of transient response parameters, analysis of first and second order system, Classification of systems, Steady state error analysis, Stability Analysis of system, Definition of BIBO stability, Routh-Hurwitz stability criterion

Frequency Response Analysis: Bode diagram, Polar plot, Nichols plot, Nyquist stability criterion, Nonmathematical description of Nyquist criterion, interpretation of stability, Relative stability – Gain and Phase margin.

Analysis of Closed Loop Systems: Root Locus Method, Properties of root locus, Sketching of root locus, Effect of open loop poles and zeros, Root locus design concepts.

State Space Analysis: Introduction, Modeling of systems using state space approach, Equivalence between poles and eigenvalues.

Text/ Reference Books:

1. R. Stefani, B. Shahrian, C. Savant & G. Hostetter, “Design of Feedback Control Systems”, Oxford University Press, 2002.
2. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1997.
3. B. C. Kuo & F. Golnaraghi, “Automatic Control Systems”, John Wiley, 2003.
4. M. Gopal, “Control Systems: Principles and Designs”, 2nd Edition, McGraw Hill, 2002.
5. R. C. Dorf & R. H. Bishop, “Modern Control Systems”, Prentice Hall, 2000
6. Norman S. Nise, “Control Systems Engineering”, Wiley India.

Subject Code: ME3P001	Name: Thermo-Fluid Lab - 1	L-T-P: 0-0-3	Credit: 2
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Pre-Requisite: None

Linear and radial heat conduction, Heat transfer through extended surfaces, Determination of heat transfer coefficient in free and forced convection, Experiments to verify various radiation

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heat transfer laws, Parallel and counter flow heat exchangers: LMTD and temperature distribution, Radiation error in temperature measurement.

Subject Code: ME3P002	Name: Casting, Welding and Forming Laboratory	L-T-P: 0-0-3	Credit: 2
Pre-Requisite: None			
Casting: Practice on CAD of gating and riser, Experiment to determine the effect of moulding variables in sand moulds, To determine the effect of mould additive on the properties of castings, To determine the characteristics of base sands. Welding: Study of arc characteristics in simulated MMA welding; arc gap-arc voltage relationship; recording of voltage oscillograms and its study. Study of heat flow and temperature distribution in welding, Study of characteristics of TIG/MIG welding, Ultrasonic/dye penetrant inspection or computer simulation of welding heat flow/analysis of arc-voltage pattern. Forming: Experiments on formability test, powder compaction; strip layout for progressive die design.			
Subject Code: ME3P003	Name: Machine Design Practice	L-T-P: 0-0-3	Credit: 2
Pre-Requisite: None			
Design and Drawing of Simple Machine Elements; Assembly Drawings; Use of CAD softwares that allows development of three-dimensional (3-D) designs; Introduction and Application of Engineering based softwares for Mechanical Engineering Applications.			

Semester-VI

Subject Code: ME3L005	Name: IC Engines	L-T-P: 3-0-0	Credit: 3
Pre-Requisite: None			
<p>Engine Classification, Components, Carnot Cycle, Stirling Cycle, Ericsson Cycle, Lenoir Cycle, Atkinson Cycle, Air standard Cycles: Otto, Diesel and Dual cycles, Fuel-Air and Actual cycles' comparison. Working principles and comparison of 2-stroke and 4-stroke SI & CI engines, Valve Timing Diagram. Important Qualities and Ratings of SI & CI Engine Fuels, Dopes, Gas Turbine Fuels. Magneto Ignition System, Battery Ignition System and Modern Ignition System for S.I. Engines, Ignition Timing. Combustion in SI & CI Engines: Stages of combustion, Ignition lag and factors affecting the lag, Flame propagation and factors affecting the propagation in SI engine, Abnormal combustion, Detonation or Knocking, Factors affecting knocking, Effects of knocking, Control of Knocking, Combustion Chambers. Simple Carburetor, Drawbacks, Complete Carburetor, Compensation. Fuel Injection of CI and SI Engines: Introduction, Requirement and Types of Injection System, MPFI System in SI engine. Engine Heat Transfer, Engine cooling and lubrication: Principle and description. Supercharging of SI and CI engines, Effect of supercharging, Limitation of supercharging, Superchargers. Performance Parameters, Measurements & Testing of I C Engines, Engine Indicator and its use, Heat balance. Pollutant Formation & its Control.</p> <p>Text/ Reference Books:</p> <ol style="list-style-type: none"> 1. Taylor C.F., Internal-combustion engine in theory and practice, Cabridge University Press. 2. Ferguson C.R., and Kirkpatrick A.T., Internal combustion engines: Applied Thermosciences, John Wiley & Sons. 3. Heywood J.B., Internal combustion engine fundamentals, McGraw-Hill. 			

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<p>4. Ganesan V., Internal combustion engines, McGraw-Hill. 5. Rogowski A.R., Elements of internal-combustion engines, McGraw-Hill.</p>			
Subject Code: ME3L006	Name: Refrigeration & Air Conditioning	L-T-P: 3-0-0	Credit: 3
Pre-Requisite: None			
<p>Refrigeration Cycles; Thermodynamic analysis of vapour-compression, aircraft refrigeration systems; Application and optimization of multistage and cascade refrigeration systems; Fan, pump, evaporator and condenser selection; Vapour absorption refrigeration systems; Refrigerants; multistage refrigeration; Load calculations; Design of various elements of a refrigeration unit. Brief history of airconditioning; Principles of psychrometry, psychrometry of airconditioning processes, comfort chart, indoor and outdoor design conditions, comfort air conditioning.</p>			
Text/ Reference Books:			
<p>1. Ameen A., Refrigeration and Air Conditioning, Prentice Hall India Learning. 2. Stocker W.F. and Jones J.W., Refrigeration and Air Conditioning, McGraw-Hill Publishing Company. 3. Dossat R.J., Principle of Refrigeration, Wiley. 4. Arora C.P., Refrigeration and Air Conditioning, McGraw-Hill. 5. Rajput R.K., Refrigeration and Air Conditioning, S. K. Kataria & Sons.</p>			
Subject Code: ME3L007	Name: Machine Tools & Machining	L-T-P: 3-0-0	Credit: 3
Pre-Requisite: None			
<p>Machine tools: - Concept and definition of machining and machine tools. History of developments of machine tools. Kinematic schemes of machine tools, Concept of producing geometrical surfaces by generatrix and directrix. Kinematic systems and structures of conventional machine tools. Electromechanical and hydraulic drives and control of machine tools. Machine tool automation. Classification and specification of machine tools. Construction, working principle and application of various semi-automatic and automatic lathes. Flexible automation: need, principle and advantages. Machining: - Tool geometry, mechanism of chip formation. Mechanics of machining. Cutting temperature: causes, effects, estimation, measurement and control. Cutting fluid applications. Failure modes, wear and life of cutting tools. Cutting tool materials. Role of geometrical and process parameters and cutting fluid on machinability. Mechanics of grinding. Economy of machining and grinding. Special techniques and advanced technology of machining and grinding.</p>			
Text/ Reference Books:			
<p>1. Rao P.N., <i>Manufacturing Technology, metal cutting & Machine tools</i>, Tata McGraw-Hill. 2. Boothroyd G., <i>Fundamentals of metal machining and machine tools</i>, Taylor & Francis. 3. Jain R.K., and Gupta S.C., <i>Production Technology</i>, Hindustan Machine Tools. 4. Hazra Chowdary S.K., <i>Elements of Workshop Technology – Vol II</i>, Media Promoters. 5. Ghosh A., and Mallik A.K., <i>Manufacturing science</i>, East-West Press.</p>			

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Subject Code: ME3L008	Name: Power Plant Engineering	L-T-P: 3-0-0	Credit: 3
Pre-Requisite: None			
<p>Introduction to Power Plant, Analysis of steam cycles, optimization of reheat pressure and degree of regeneration, coupled cycles and combined plants, process heat and power. Boilers: Different types of boilers, boiler mountings & accessories, feed water treatment, boiler energy balance & draft system. Nozzles; convergent and convergent-divergent nozzles - theory and design. Steam Turbines: Impulse and reaction turbines, compounding of turbines, optimum velocity ratio, reheat factor and condition line, parallel exhaust, losses in steam turbines, steam turbine governing. Theory and design of condensers, air ejector and cooling tower. Fluid Power & Machinery: Similarity, Euler equation for Turbo-machines, Centrifugal pump, Hydraulic turbines, Cavitation.</p> <p>Text/ Reference Books:</p> <ol style="list-style-type: none"> 1. El-Wakil M.M., Power Plant Technology, McGraw-Hill Science/Engineering/Math. 2. Nag P.K., Power Plant Engineering, Tata McGraw Hill Publishing Company Limited. 3. Veatch B., Drbal L.F., Boston P.G., Westra K.L., Erickson R.B., Power Plant Engineering, CBS Publishers. 4. Rajput R.K., A Textbook of Power Plant Engineering, Laxmi Publication. 5. Som S.K., and Biswas G., Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Publishing Company Limited. 			
Subject Code: ME3P004	Name: Thermo-Fluid Lab - 2	L-T-P: 0-0-3	Credit: 2
Pre-Requisite: None			
<p>Study of I.C. Engine models, Load test on a Petrol engine, Load test on a Diesel engine and Morse test on a multi-cylinder engine. Studies on refrigerant compressors. Experimental observations on a refrigeration test-rig. Performance evaluation of a vapour compression refrigeration system. Performance evaluation of an air conditioning system Pressure distribution for flow over a cylinder, measurement of velocity profile in the boundary layer, characteristics of a convergent-divergent nozzle and characteristics of a centrifugal fan.</p>			
Subject Code: ME3P005	Name: MTM Laboratory	L-T-P: 0-0-3	Credit: 2
Pre-Requisite: None			
<p>Machine tools: 1. Acceptance test of machine tool (radial drilling machine) 2. System compliance of machine tool (center lathe). Machining: 3. Resharpening of turning tool to specific geometry 4. Measurement of cutting forces and surface finish in turning, drilling and milling 5. Measurement of cutting temperature and tool life in turning 6. Measurement of grinding forces and surface finish in grinding 7. Machine setting and operation for helical gear teeth cutting. Metrology: 8. Inspection of straightness and flatness of surfaces Measurement of angles 9. Measurement of external and internal taper 10. Inspection of screw threads 11. Inspection of gear teeth 12. Measurement of roundness by Telerond Calibration of measuring instruments.</p>			

Lateral Subject Syllabus (I, II and III)

Lateral-I

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Subject Code: ME2L501	Name: Elements of Mechanical Engineering	L-T-P: 3-1-0	Credit: 4
Pre-Requisite: None			
<p>Engineering Materials: Classification of Engineering Materials, Mechanical Properties, Ferrous & Nonferrous materials, Composite materials, Testing of Materials.</p> <p>Thermodynamics: Introduction, Laws of Thermodynamics, Mass and Energy balance, Mechanical equivalent of heat, Internal energy, Enthalpy, Entropy, Work and Heat Transfer, Properties of Gas and Steam, Steam Boilers and Turbines, Refrigeration and Air Conditioning, Thermodynamic Cycles, IC Engines.</p> <p>Fluids and Fluid Machinery: Properties of fluid, Pascal law, Pressure variation in a Static Fluid, Relationship between Atmospheric, Absolute Gauge and Vacuum Pressure, Manometers, Laminar and Turbulent Flow, Pumps, Air Compressors, Turbines, Hydro-Electric Power Plants, Hydraulic Machines.</p> <p>Measurement and Machine Tools: Measurement of Engineering Quantities, Error and Uncertainty in Measurement, Measuring Instruments and Introduction to Machine Tools. Machine Elements and Drives: Shafts, Keys, Couplings, Bearings, Flywheel, Governor, Belt drive, Chain drive, Gear trains, clutch and brakes.</p> <p>Text/ Reference Books:</p> <ol style="list-style-type: none"> 1. Callister, Materials Science and Engineering, Wiley. 2. Boles M.A., and Cengel Y.A., Thermodynamics: An Engineering Approach (SI Units), Tata McGraw - Hill Education. 3. Bevan T., The Theory of Machines, Pearson. 4. Kalpakjian S., and Schmid S.R., Manufacturing Engineering and Technology, Pearson. 5. Cimbala J.M., and Cengel Y.A., Fluid Mechanics: Fundamentals and Applications (In SI Units), Tata McGraw - Hill Education. 6. Ganesan V., Internal Combustion Engines, Tata Mc-Graw Hill Publishing Co. Ltd. 7. Beckwith T.G., Mechanical Measurements, Pearson. 			
Lateral-II			
Subject Code: ME3L501	Name: Applied Thermodynamics	L-T-P: 3-0-0	Credit: 3
Pre-Requisite: None			
<p>Basics of Thermodynamics, First law for a closed system; Steady flow energy equation; Second law of Thermodynamics, Entropy; Refrigeration: Mechanical vapor compression refrigeration cycles - RC cycle, single stage saturation cycle, effects of sub-cooling and superheating, Properties of refrigerants. Reciprocating compressor- volumetric efficiency and work requirement. Multistage, multi-evaporator and cascade refrigeration cycles. Gas cycle refrigeration; Air-conditioning: Principles of psychrometry and psychrometry processes. Summer and Winter air-conditioning; I C Engines: Introduction to IC Engines, Otto, Diesel, Dual & Stirling Cycles. Comparison of cycles; Thermal Power plant Cycles: Introduction to Thermal Power Plants, Rankine cycle; Reheat and regenerative cycles; Heat Transfer: Basics of Heat Transfer, Conduction: mechanism; Fourier's general conduction equation in 3-D; 1-D steady state conduction with heat generation: composite plane wall and cylinders, thermal resistance network, critical thickness of insulation; extended surface heat transfer, Applications to problems involving Conduction, convection and radiation heat transfer.</p>			

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Text/ Reference Books:			
1. Boles M.A., and Cengel Y.A., Thermodynamics: An Engineering Approach, Tata McGraw – Hill Education.			
2. Nag P.K., Engineering Thermodynamics, Tata McGraw – Hill.			
3. Cengel Y., Heat Transfer: A Practical Approach, McGraw-Hill Professional.			
4. Incropera, Bergman, and DeWitt, Fundamentals of Heat and Mass Transfer, John Wiley & Sons Inc.			
5. Arora C.P., Refrigeration and Air-Conditioning, Tata McGraw – Hill.			
6. Stoecker W.F. and Jones J.W., Refrigeration and Air-Conditioning, McGraw-Hill.			
7. Nag P.K., Power Plant Engineering, Tata McGraw – Hill.			
8. Taylor C.F., Internal-combustion engine in theory and practice, Cambridge University Press.			
Subject Code: ME3L502	Name: Introduction to CAD/CAM	L-T-P: 3-0-0	Credit: 3
Pre-Requisite: None			
Introduction, product life cycle, I/O and storage devices, 3D transformations, clipping, hidden surface removal, geometric modeling, curve and surface representation methods, basic geometric commands. Introduction to NC, CNC and DNC, part programming, group technology, flexible manufacturing system and computer aided quality control.			
Text/ Reference Books:			
1. Zimmers & Groover P., CAD/CAM, PE/PHI Publishers.			
2. Zeid I., CAD / CAM Theory and Practice, Tata McGraw – Hill.			
3. Rao P.N., CAD/CAM principles and applications, Tata McGraw – Hill.			
4. Korean Y., Computer control of Machine Tools and Processes.			
5. Groover, Automation, Production systems & Computer integrated Manufacturing, Pearson Education.			
6. Amirouche F., Principles of Computer Aided Design and Manufacturing, Pearson Education.			
7. Seames W.S., Computer Numerical Control Concepts and programming, Thomson Learning.			
Lateral-III			
Subject Code: ME3L503	Name: Introduction to Robotics	L-T-P: 3-0-0	Credit: 3
Pre-Requisite: None			
Introduction to robotics, classification of robots, robot components, degree of freedom, robot joints, coordinates, work space analysis, robot languages, applications of robots, characteristics of actuation systems, hydraulic, pneumatic and electric actuation systems, feed-back components, position sensors, velocity sensors; Robot as a mechanism, matrix representation, representation of a frame and rigid body, homogeneous transformation matrices, forward and inverse kinematics of robots, Denavit-Hartenberg (D-H) representation of forward kinematic equations of robots, inverse kinematic solution of robots, dynamics and trajectory planning.			
Text/ Reference Books:			

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<ol style="list-style-type: none"> 1. Ghosal A., Robotics: Fundamental concepts and analysis, Oxford university press. 2. Groover M.P., Industrial Robotics, Pearson Education. 3. Mittal R.K., and Nagrath I.J., Robotics and Control, Tata Mc-Graw Hill. 4. Fu K., Gonzalez R., and Lee C. S. G., Robotics: Control, sensing, vision and intelligence, McGraw Hill. 5. Klafter R.D., Robotic Engineering, Prentice Hall. 6. Craig J.J., Introduction to Robotics, Pearson Education. 7. Spong M.W., and Vidyasagar M., Robot Dynamics & Control, John Wiley & Sons (ASIA) Pte Ltd. 8. Saha S.K., Introduction to robotics, Tata Mc-Graw Hill. 9. Jazar R.N., Theory of applied robotics, kinematics, dynamics and control, Springer. 			
Subject Code: ME3L504	Name: Industrial Engineering & Management	L-T-P: 3-0-0	Credit: 3
Pre-Requisite: None			
<p>Introduction to Industrial Engineering, Productivity, ways to improve productivity, time study, work measurement, Ergonomics, types of Production systems, Plant Layouts, Assembly lines, plant locations, product life cycle, design process of product, rapid prototyping, break even analysis, profit volume graph, quality control, total quality management, ISO, statistical quality control, acceptance sampling, Forecasting, Forecasting Techniques, scheduling, Material resource planning, inventory control, inventory models, EOQ, Safety Stock, ABC Analysis, JIT, project management, PERT and CPM, Project crashing, Reliability and maintenance, Replacement, Principle of management, organization charts, job evaluation, merit rating, wage incentive systems.</p> <p>Text/ Reference Books:</p> <ol style="list-style-type: none"> 1. Shankar R., Engineering, Galgotia Publication. 2. Salvendy G., Handbook of Industrial Engineering: Technology and Operations Management, Wiley publication. 3. Buffa, Modern production/operations management, Wiley India. 4. Krajewski, Operations management, Pearson Education. 			

Elective Subject (I) Syllabus

Subject Code: ME3L012	Subject Name: Operations Research	L-T-P: 3-0-0	Credit: 3
Pre-Requisite: None			
<p>Introduction of Operations Research, Applications of OR, Linear Programming: Formulation Linear Programming, Graphical method, Simplex method, Duality, Sensitivity Analysis, Transportation problem: Initial basic feasible solution, Optimality test, Special cases of Assignment Problem, Integer Linear Programming, Branch and Bound Method, Sequencing Problem, Game Theory: two person zero sum game problem,</p>			

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Games with mixed strategy, Project scheduling: CPM, PERT, Project Crashing, Multi Criteria Decision Making Tools, Queuing Theory: multiple server models, Simulation.

Text/ Reference Books:

1. Hillier F.S., and Lieberman G.J., Introduction to Operations Research, Tata McGraw Hill, New York.
2. Taha H.A., Operations Research: An Introduction, Prentice-Hall, New York.
3. Winston W.L., Operations Research: Applications and Algorithms, Duxbury Press, Belmont.
4. Ravindran and Phillip, Operations Research, Wiley publication.

Subject Code: ME3L013	Subject Name: Computational Fluid Dynamics	L-T-P: 3-0-0	Credit: 3
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Pre-Requisite: Fluid Mechanics

Basic conservation equations for fluid flow and heat transfer, classification of partial differential equations and pertinent physical behavior, parabolic, elliptic and hyperbolic equations, role of characteristics; Common methods of discretisation: an overview of finite difference and finite volume methods; Numerical solution of parabolic partial differential equations using finite-difference and finite-volume methods: explicit and implicit schemes; Consistency, stability and convergence; Numerical solution of systems of linear algebraic equations: iterative methods, tridiagonal matrix algorithm, Jacobi and Gauss-Seidel iterations, necessary and sufficient conditions for convergence of iterative schemes; The finite volume method of discretisation for diffusion problems; Convection-diffusion problems; Numerical solution of the Navier-Stokes system for incompressible flows.

Text/ Reference Books:

1. Patankar S.V., Numerical Heat Transfer and Fluid Flow, Taylor and Francis.
2. Versteeg H.K., and Malalasekera W., Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson Publisher.
3. Tannehill J.C., Anderson D.A., and Pletcher R.H., Computational Fluid Mechanics and Heat Transfer, Taylor and Francis Group.
4. Anderson Jr. D.A., Computational Fluid Dynamics, McGraw-Hill Publisher.
5. Smith G.D., Numerical Solution of Partial Differential Equations: Finite Difference Methods, Oxford University Press.

Subject Code: ME3L014	Subject Name: Robotics	L-T-P: 3-0-0	Credit: 3
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Pre-Requisite: None

Introduction, brief history, components, types and classification of robots, Homogeneous transformations, representation of joints and links using D-H parameters, direct and inverse kinematics of manipulators, examples of kinematics of some common manipulator configurations, Jacobian and dynamics of manipulators, trajectory planning; Purpose and types of sensors, Internal and external sensors, common sensors– displacement sensors, velocity sensors, force sensors and vision, necessity of actuators,

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different kinds of actuators – stepper motors, DC servo and brushless motors, programming of robots.

Text/ Reference Books:

1. Ghosal A., Robotics: Fundamental concepts and analysis, Oxford university press.
2. Groover M.P., Industrial Robotics, Pearson Education.
3. Mittal R.K., and Nagrath I.J., Robotics and Control, Tata Mc-Graw Hill.
4. Fu K., Gonzalez R., and Lee C. S. G., Robotics: Control, sensing, vision and intelligence, McGraw Hill.
5. Klafter R.D., Robotic Engineering, Prentice Hall.
6. Craig J.J., Introduction to Robotics, Pearson Education.
7. Spong M.W., and Vidyasagar M., Robot Dynamics & Control, John Wiley & Sons (ASIA) Pte Ltd.
8. Saha S.K., Introduction to robotics, Tata Mc-Graw Hill.
9. Jazar R.N., Theory of applied robotics, kinematics, dynamics and control, Springer.

Subject Code: ME3L015	Subject Name: Intermediate Fluid Mechanics	L-T-P: 3-0-0	Credit: 3
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Pre-Requisite: Fluid Mechanics

Review: Differential form of Conservation Equations of Mass, Momentum & Energy, N-S Equations for Incompressible Flows; Velocity Potential, Stream-function; Vorticity & Circulation; Potential Flows – Elementary plane flows, superposition, plane flow past closed body shapes, flow past cylinder (Lifting & Non-lifting) – lift & drag, Complex Potential & Conformal mapping, Image & Reflections, Applications to plane flows; Vortex Lines, Kelvin-Helmholtz Theorems, Biot-Savart Law & Induced Velocity; Airfoil theory – Kutta conditions, lifting-line theory; Boundary Layer – Equations, Approximate & Exact solutions; Introduction to Stability, Transition & Turbulence.

Text/ Reference Books:

1. White F.M., Fluid Mechanics, Tata McGraw Hill Publishing Company Limited.
2. Anderson J.D., Fundamentals of Aerodynamics, McGraw Hill.
3. Fox R.W., and McDonald A.T., Introduction to Fluid Mechanics, John Wiley & Sons, Inc.
4. Panton R.L., Incompressible Flow, Wiley.
5. White F.M., Viscous Fluid Flow, McGraw-Hill.
6. Schlichting H., and Gersten K., Boundary Layer Theory, Springer.
7. Kundu P.K., and Cohen I.M., Fluid Mechanics with Multimedia DVD, AP / Elsevier.
8. Munson B.R., Young D.F., Okiishi T.H., and Huebsch W.W., Fundamentals of Fluid Mechanics, Wiley.

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B. TECH DEGREE (7TH SEMESTER AND 8TH SEMESTER COURSES) MECHANICAL ENGINEERING

SEMESTER - VII					
Subject Name	Code	L-T-P	Credit	Contact Hour	Syllabus Page No.
Elective - 2	ME4LXXX/ ME6LXXX	3-0-3	5	6	
Elective - 3	ME4LXXX/ ME6LXXX	3-0/1-0	3/4	3/4	
Breadth - 2		3-0/1-0	3/4	3/4	
Summer Training	ME4T001	0-0-3	2	3	
Project - Part 1	ME4D001	0-0-6	4	6	
		Total	17/19	21/23	
SEMESTER - VIII					
Breadth - 3	XXX XXXX	3-0-0	3	3	
Breadth - 4	XXX XXXX	3-0/1-0	3/4	3/4	
Elective - 4	ME4LXXX/ ME6LXXX	3-0/1-0	3/4	3/4	
Elective - 5	ME4LXXX/ ME6LXXX	3-0-0	3	3	
Project - Part 2	ME4D002	0-0-9	6	9	
		Total	18/20	21/23	
		G. Total	177/185	205/207	

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BTECH 7TH AND 8TH SEMSEMTER ELECTIVES LIST

ELECTIVE II					
Subject Name	Code	L-T-P	Credit	Contact Hour	Syllabus Page No.
Computer Aided Design and Manufacturing	ME4L002	3-0-3	5	6	50
Advanced Manufacturing Processes	ME4L004	3-0-3	5	6	50
Experimental Techniques for Thermo-Fluids Applications	ME6L115	3-0-3	5	6	65
Non-Conventional Energy Systems	ME6L116	3-0-3	5	6	65
Design and Experimental Analysis of welded Joints	ME6L311	3-0-3	5	6	80
Metal Forming Theory and Practice	ME6L312	3-0-3	5	6	81
ELECTIVES III, IV, and V					
Subject Name	Code	L-T-P	Credit	Contact Hour	Syllabus Page No.
Air-Conditioning and Ventilation	ME4L005	3-0-0	3	3	51
Supply Chain Management	ME4L006	3-0-0	3	3	51
Automobile Engineering	ME4L009	3-0-0	3	3	52
Quality Control	ME4L010	3-0-0	3	3	52
Work System Design	ME4L011	3-0-0	3	3	52
Tribology	ME6L005	3-1-0	4	4	54
Engineering Design Optimization	ME6L007	3-0-0	3	3	54
Sensing and Actuation	ME6L008	3-0-0	3	3	54
Engineering Measurements	ME6L009	3-1-0	4	4	55
Operations Management	ME6L010	3-0-0	3	3	55
Finite Element Methods in Engineering	ME6L011	3-1-0	4	4	56
Acoustics	ME6L012	3-1-0	4	4	56
Robotics and Automation	ME6L013	3-0-0	3	3	56
Introduction to Nonlinear Dynamics	ME6L014	3-0-0	3	3	57
Industrial Noise Control	ME6L053	3-0-0	3	3	58
Experimental Stress Analysis	ME6L056	3-0-0	3	3	59
Theory of Composite Materials	ME6L057	3-0-0	3	3	59

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Experimental Modal Analysis	ME6L058	3-0-0	3	3	59
Soft Computing and Applications	ME6L060	3-1-0	4	4	60
MEMS & Microsystems Technology	ME6L062	3-0-0	3	3	60
Reverse Engineering	ME6L063	3-0-0	3	3	61
Fracture Mechanics	ME6L064	3-1-0	4	4	61
Computational Methods in Thermal & Fluid Engineering	ME6L102	3-1-0	4	4	62
Conduction & Radiation Heat Transfer	ME6L104	3-0-0	3	3	63
Air-Conditioning and Ventilation	ME6L107	3-0-0	3	3	63
Two Phase Flow Heat Transfer	ME6L112	3-0-0	3	3	63
Spectral Methods for Engineering & Scientific Computing Applications	ME6L113	3-0-0	3	3	64
Solar Energy	ME6L114	3-0-0	3	3	64
Introduction to Atmospheric Radiation	ME6L117	3-0-0	3	3	66
Statistical Thermodynamics	ME6L118	3-0-0	3	3	67
Micro/Nano Scale Heat Transfer	ME6L119	3-0-0	3	3	67
Mathematical Methods for Mechanical Engineers	ME6L120	3-0-0	3	3	67
Structural Health Monitoring	ME6L121	3-0-0	3	3	68
Convective Heat & Mass Transfer	ME6L153	3-0-0	3	3	69
Conduction and Change of Phase Heat Transfer	ME6L154	3-0-0	3	3	70
Turbulence	ME6L155	3-0-0	3	3	70
Refrigeration Systems	ME6L156	3-0-0	3	3	71
Transport Phenomenon in Material Processing	ME6L157	3-0-0	3	3	71
Boiling and Condensation	ME6L158	3-0-0	3	3	72
Heat and Mass Transfer in Biological Systems	ME6L159	3-0-0	3	3	72
Microfluidics	ME6L160	3-0-0	3	3	73
Experimental Fluid Mechanics	ME6L161	3-1-0	4	4	73
Nuclear Power, Generation & Safety	ME6L162	3-0-0	3	3	74
High Performance Computing in Thermo-Fluids Applications	ME6L163	3-0-0	3	3	74
Numerical Methods in Radiative	ME6L164	3-0-0	3	3	74

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Heat Transfer					
Principles of Turbo Machinery	ME6L165	3-0-0	3	3	75
Geophysical Fluid Dynamics	ME6L166	3-0-0	3	3	75
Design of Heat Exchangers	ME6L167	3-0-0	3	3	75
Lattice Boltzmann Modelling	ME6L168	3-0-0	3	3	76
Fluid Structure Interaction and Separated Flows	ME6L169	3-0-0	3	3	76
Analytical Combustion	ME6L170	3-0-0	3	3	76
Applications of Linear Algebra in Mechanical Engineering	ME6L171	3-0-0	3	3	77
Advanced Casting Processes	ME6L313	3-0-0	3	3	82
Solid state joining processes	ME6L314	3-1-0	4	4	83
Quality Engineering and Management	ME6L315	3-0-0	3	3	84
Surface Engineering	ME6L317	3-0-0	3	3	84
Numerical Methods for Manufacturing	ME6L318	3-1-0	4	4	85
Supply Chain Management	ME6L319	3-0-0	3	3	85
Digital Manufacturing	ME6L320	3-1-0	4	4	86
Additive Manufacturing	ME6L331	3-0-0	3	3	87
Factory Automation	ME6L332	3-0-0	3	3	88
Manufacturing Planning and Control	ME6L316	3-0-0	3	3	88
Advanced Tooling Design	ME6L321	3-0-0	3	3	89
Metrology and Computer Aided Inspection	ME6L322	3-1-0	4	4	90
Operations Management	ME6L323	3-0-0	3	3	90
Machine Tool Design	ME6L324	3-1-0	4	4	91
Lasers in Manufacturing	ME6L327	3-1-0	4	4	91
Precision and Micro Manufacturing	ME6L329	3-1-0	4	4	92
Data Analytics	ID6L001	3-0-0	3	3	78
Design and Analysis of Experiments	ID6L002	3-0-0	3	3	78