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SCHOOL OF MECHANICAL ENGINEERING

CURRICULUM FOR APPLIED LEARNING

B.Tech Mechanical Engineering

(2015 - 16 Batch onwards)

Breakup of Courses

Sl. No.	Category	Credits
1	University Core	70
2	University Elective	12
3	Programme Core	62
4	Programme Elective	36
	Minimum credits required to qualify	180
	Credits Offered	180

Category-wise Breakup of Credits

Category	Proposed Number of Credits	Proposed Credit Distribution (%)
Engineering	108	60
Sciences	45	25
Humanities	18	10
Management	09	5
Total	**180**	**100**

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University Core Courses

Course Code	Course Title	L	T	P	J	C	Area	Prerequisite
STS1001/ 1002/2001/ 2002/3001/ 3002	Soft Skills* [6x1 credit each]	0	0	0	0	1 (6)	Humanities	Nil
FLC4097	Foreign Language (basket)	1	0	2	0	2	Humanities	Nil
ENG1011	English for Engineers	1	0	2	0	2	Humanities	Nil
CSE1001	Problem Solving and Programming	0	0	6	0	3	Engineering	Nil
CSE1002	Problem Solving and Object Oriented Programming	0	0	6	0	3	Engineering	Nil
MAT1011	Calculus for Engineers	3	0	2	0	4	Science	Nil
MAT2001	Statistics for Engineers	2	1	2	0	4	Science	MAT1011
PHY1001	Engineering Physics	3	0	2	4	5	Science	Nil
CHY1001	Engineering Chemistry	3	0	2	4	5	Science	Nil
HUM1021	Ethics and Values	1	0	0	4	2	Humanities	Nil
EXE4097	Personality Development (Co/Extra-curricular Activity)	0	0	0	0	2	Management	Nil
MGT1022	Lean Start-up Management	1	0	0	4	2	Management	Nil
PHY1999	Introduction to Innovative Projects	1	0	0	4	2	Science	Nil
CHY1002	Environmental Sciences	2	0	0	4	3	Science	Nil
MEE3999	Tech Answers for Real world Problems	1	0	0	8	3	Engineering	PHY1999
MEE4098	Comprehensive Examination	0	0	0	0	2	Engineering	End of 7th Semester
MEE4099	Capstone Project (1 Semester)	0	0	0	0	20	Engineering	Completion of 7 semesters
	Total					**70**		

***Project Based Courses (PBCs) – 13**

University Elective:

Course Title	Credit	Area
Science Elective - I	3	Science
Science Elective - II	3	Science
Humanities Elective - I	3	Humanities
Management Elective – I	3	Management
Total	**12**	

Program Core Courses (61 Credits)

	Course Title	L	T	P	J	C	Area	Pre requisites
EEE1001	Basic Electrical & Electronics Engineering	2	0	2	0	3	Engineering	Nil
MAT2002	Applications of Differential and Difference Equations	3	0	2	0	4	Science	MAT1011
MAT3003	Complex variables and Partial Differential Equations	3	1	0	0	4	Science	MAT2002
MAT3005	Applied Numerical Methods	3	1	0	0	4	Science	MAT2002
MEE1001	Engineering Drawing	1	0	4	0	3	Engineering	Nil
MEE1002	Engineering Mechanics	2	1	0	0	3	Engineering	Nil
MEE1003	Engineering Thermodynamics	2	1	0	0	3	Engineering	Nil
MEE1004	Fluid Mechanics	2	1	2	0	4	Engineering	Nil
MEE1005	Materials Engineering and Technology	2	0	2	4	4	Science/ Engineering	Nil
MEE1007	Manufacturing Processes	2	0	2	0	3	Engineering	Nil
MEE2001	Machine Drawing	1	0	2	4	3	Engineering	MEE1001
MEE2002	Strength of Materials	2	1	2	0	4	Engineering	MEE1002
MEE2003	Thermal Engineering Systems	2	1	2	0	4	Engineering	MEE1003
MEE2004	Mechanics of Machines	2	1	0	4	4	Engineering	MEE1002
MEE2005	Heat Transfer	2	1	0	4	4	Engineering	MEE1003
MEE2006	Machining Process and Metrology	2	0	0	4	3	Engineering	MEE1007
MEE3001	Design of Machine Elements	2	1	0	0	3	Engineering	MEE2002
MEE3099	Industry Internship*	0	0	0	0	2	Engineering	After 2 years
	TOTAL CREDITS					**62**		

***Project based courses (PBC) -6**

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Proposed Program Electives (36 Credits to be earned): (31+ 3 + 2)

S. No	Course Code	Course Title	L	T	P	J	C	Category	Pre-requisite
1.		Humanities Elective					3	Humanities	Nil
2.		Management Elective					2	Management	Nil
3.	CHE2006	Fuels and combustion	3	0	0	0	3	Engineering	MEE1003
4.	EEE2007	Electronics and Micro controllers*	2	0	0	4	3	Engineering	EEE1001
5.	EEE3001	Control systems	3	0	2	0	4	Engineering	EEE1001
6.	MEE1008	MEMS	3	0	0	0	3	Engineering	Nil
7.	MEE1009	New Product Development	2	0	0	4	3	Engineering	Nil
8.	MEE1011	Renewable Energy sources	2	0	2	4	4	Engineering	Nil
9.	MEE1012	Alternative Fuels	3	0	0	0	3	Engineering	Nil
10.	MEE1014	Industrial Engineering and Management	2	0	0	4	3	Engineering	Nil
11.	MEE1015	Total quality management and Reliability	3	0	0	0	3	Engineering	Nil
12.	MEE1016	Lean Enterprises and New Manufacturing Technology	3	0	0	0	3	Engineering	Nil
13.	MEE1017	New Venture Planning and Management	2	0	0	4	3	Engineering	Nil
14.	MEE1018	Facilities and Process Planning	3	0	0	0	3	Engineering	Nil
15.	MEE1024	Operations Research	2	1	0	0	3	Engineering	MAT2001
16.	MEE1027	Instrumentation and Control Engineering	2	0	2	4	4	Engineering	Nil
17.	MEE1030	Robotics	2	0	0	4	3	Engineering	Nil
18.	MEE2007	CAD/CAM	2	0	2	4	4	Engineering	MEE1007
19.	MEE2008	Product Design for Manufacturing	2	0	0	4	3	Engineering	MEE1007
20.	MEE2009	Tribology	2	1	0	0	3	Engineering	MEE1002, MEE1004
21.	MEE2010	Design of Composite Materials	2	1	0	0	3	Engineering	MEE1005
22.	MEE2011	Welding Engineering	2	0	0	4	3	Engineering	MEE1007
23.	MEE2012	Manufacturing Automation	2	0	2	4	4	Engineering	MEE1007
24.	MEE2013	Modelling and simulation of Manufacturing Systems	3	0	0	4	4	Engineering	MEE1007
25.	MEE2014	Metal Casting Technology	2	0	0	4	3	Engineering	MEE1007
26.	MEE2015	Non-Destructive testing	2	0	2	4	4	Engineering	MEE1005
27.	MEE2016	Rapid Manufacturing Technologies	2	0	0	4	3	Engineering	MEE1007
28.	MEE2019	Materials Characterization Techniques	2	0	0	4	3	Engineering	MEE1005
29.	MEE2020	Metal Forming Theory and Practice	3	0	0	0	3	Engineering	MEE1007
30.	MEE2022	Power Plant Engineering	2	0	0	4	3	Engineering	MEE1003

31.	MEE2023	Gas dynamics and Jet propulsion	2	1	0	0	3	Engineering	MEE1003, MEE1004
32.	MEE2025	Fluid Power systems	3	0	2	0	4	Engineering	MEE1004
33.	MEE2026	Turbomachines	2	0	2	4	4	Engineering	MEE1003, MEE1004
34.	MEE3002	Finite Element Analysis	2	1	0	4	4	Engineering	MEE2002, MAT3005
35.	MEE3003	Engineering Failure Analysis	3	0	0	4	4	Engineering	MEE2002
36.	MEE3004	Internal Combustion Engines	3	0	0	0	**3**	Engineering	MEE2003
37.	MEE3005	Refrigeration and Air Conditioning	2	1	0	4	4	Engineering	MEE2003
38.	MEE3006	Automobile Engineering	2	0	2	0	3	Engineering	MEE2003
39.	MEE3008	Mechanical Vibrations	2	1	2	0	4	Engineering	MEE2004
40.	MEE3010	Robot Dynamics and Applications	3	0	0	0	3	Engineering	MEE2004
41.	MEE4001	Tool design	3	0	0	4	4	Engineering	MEE2006
42.	MEE4002	Advanced Machining Processes	2	0	0	4	3	Engineering	MEE2006
43.	MEE4003	Micro and Nano Machining	3	0	0	0	3	Engineering	MEE2006
44.	MEE4005	Surface Engineering	3	0	0	0	3	Engineering	MEE2006
45.	MEE4006	Computational Fluid Dynamics	2	1	2	0	4	Engineering	MEE1004, MEE2005, MAT3005
46.	MEE4007	Design of Transmission Systems	2	1	0	4	4	Engineering	MEE2004/ MEE3001

No of *Project based courses (PBC) offered under Program Electives- 24

PROGRAMME CORE COURSES

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Course Code: EEE1001	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	J	C
Pre-requisite: NIL		2	0	2	0	3

Module	Topics	L Hrs	SLO
1	**DC circuits:** Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Thevenin's and Maximum power transfer theorem.	5	1, 2,9
2	**AC circuits:** Alternating voltages and currents, AC values, Single Phase RL, RC, RLC Series circuits, Power in AC circuits-Power Factor- Three Phase Systems – Star and Delta Connection- Three Phase Power Measurement – Electrical Safety –Fuses and Earthing, Residential wiring.	6	1, 2, 9
3	**Electrical Machines:** Construction, Working Principle and applications of DC Machines, Transformers, Single phase and Three-phase Induction motors, Special Machines-Stepper motor, Servo Motor and BLDC motor	7	1,2
4	**Digital Systems:** Basic logic circuit concepts, Representation of Numerical Data in Binary Form- Combinational logic circuits, Synthesis of logic circuits.	5	1,2
5	**Semiconductor devices and Circuits:** Conduction in Semiconductor materials, PN junction diodes, Zener diodes, BJTs, MOSFETs, Rectifiers, Feedback Amplifiers using transistors. **Communication Engineering:** Modulation and Demodulation - Amplitude and Frequency Modulation	7	1, 2
	Total Lecture Hours	30	

 # Mode: Flipped Class Room, Use of physical and computer models to lecture, visit to industries. Minimum of 2 lectures by industry experts.

Upon completion of this course, students should be able to use standard laboratory equipment to analyze the characteristics of basic electronic devices and to design and construct simple circuits containing these devices.

- Experiments should be application based
- Provide Circuit design experience.
- Use P-Spice / Matlab as circuit simulation tools.

Sample Laboratory Experiments: (Hardware and Simulation)

1. Thevenin's and Maximum Power Transfer Theorems – Impedance matching of source and load.
2. Sinusoidal steady state Response of RLC circuits.
3. Three phase power measurement for ac loads.
4. Staircase wiring circuit layout for multi storey building.
5. Fabricate and test a PCB layout for a rectifier circuit.
6. Half and full adder circuits.
7. Full wave Rectifier circuits used in DC power supplies. Study the characteristics of the semiconductor device used.
8. Regulated power supply using zener diode. Study the characteristics of the Zener diode used.
9. Lamp dimmer circuit (Darlington pair circuit using transistors) used in cars.

15 | **5, 14,17**

Study the characteristics of the transistor used. 10. Characteristics of MOSFET.		

Text Books:

1. John Bird, 'Electrical circuit theory and technology', Newnes publications, 4th Edition, 2010.

Reference Books

1. Allan R. Hambley, 'Electrical Engineering-Principles & Applications' Pearson Education, First Impression, 6/e, 2013.
2. Simon Haykin, 'Communication Systems', John Wiley & Sons, 5th Edition, 2009.
3. Charles K Alexander, Mathew N O Sadiku, 'Fundamentals of Electric Circuits', Tata McGraw Hill, 2012.
4. Batarseh, 'Power Electronics Circuits', Wiley, 2003.
5. W. H. Hayt, J.E. Kemmerly and S. M. Durbin, 'Engineering Circuit Analysis', 6/e, Tata McGraw Hill, New Delhi, 2011.
6. Fitzgerald, Higgabogan, Grabel, 'Basic Electrical Engineering', 5th edn, McGraw Hill, 2009.
7. S.L.Uppal, 'Electrical Wiring Estimating and Costing', Khanna publishers, NewDelhi, 2008.

Mode of Evaluation	Continuous Assessment includes CAT I/II, Assignments/Quizzes, Practical (60%), Term End Examination (40%)
Recommended by the Board of Studies on:	05.06.2015
Date of Approval by the Academic Council:	16.06.2015
Compiled by	

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Course Code: MAT2002	APPLICATIONS OF DIFFERENTIAL AND DIFFERENCE EQUATIONS					
Pre-requisite: MAT1011		L	T	P	J	C
		3	0	2	0	4

Module	Topics	L Hrs	S LO
1	**Matrices:** Matrices: eigen values and eigen vectors - properties of eigen values and eigen vectors- -similarity of transformationorthogonal transformation	6	1,2,7,9
2	**Fourier series**: Fourier series -Euler's formulae- Dirichlet's conditions - change of interval-half range series – RMS value – Parseval's identity – computation of harmonics	6	1,2,7,9
3	**Solution of Ordinary differential equations :** Linear second order ordinary differential equation with constant coefficients– solutions of homogenous and non homogenous equations-method of undetermined coefficients –method of variation of parameters-Solutions of Cauchy-Euler and Cauchy Legendre differential equations	6	1,2,7,9
4	**Strum Liouville Problems and Power Series Solutions :** The Strum-Liouville Problem-orthogonality of eigen functions - Series solutions of differential equation about ordinary and regular singular points-Legendre differential equations - Bessel's differential equations -	6	1,2,7,9
5	**Solution of system of equations by matrix approach** Solving non homogeneous first order system of differential equations(x'+Ax= g)- reduction of nth order differential equation to first order system.	5	1,2,7,9
6	**Solution of differential equations through Laplace transform:** Solution of ODEs - Non homogeneous terms involving Heaviside function-impulse function- Solving non homogeneous system using Laplace transform.	5	1,2,7,9
7	**Z-Transform**: Z-transform-relation between Z-transform and Laplace transforms – Z transforms of standard functions-inverse Ztransforms :by partial fraction method, by convolution method	5	1,2,7,9
8	**Difference equation:** Difference equation-first and second order difference equations with constant coefficients-Fibonacci sequencesolution of difference equations-complementary functions - particular integrals by the method of undetermined coefficients -	6	1,2,7,9
	Total Lecture Hours	45	

Mode:

- Introducing Uni ts through Engineering appl icat ions -Visual izing the concepts through MATLAB,
- Working on Engineer ing problems through Mathemat ical Sof tware(MATLAB, MATHEMATICA, MAPLE, SAGE etc)
- Class room teaching
- Min of 2 lectures by experts

Tutorial	Non- contact Hours

Minimum of 10 problems per module **Mode**: Individual Exercises to be submi t ted to designated RAs		
Laboratory Exercises Understanding of the concepts through Mathemat ics LAB – 12 experiments • Solving Homogeneous differential equations arising in engineering problems • Solving non-homogeneous differential equations and Cauchy, Legendre equations • Applying the technique of Laplace transform to solve differential equations • Applications of Second order differential equations to Mass spring system (damped, • undamped, Forced oscillations) , LCR circuits etc • Visualizing Eigen value and Eigen vectors • Solving system of di fferential equations arising in engineering applications • Applying the Power series method to solve differential equations arising in engineering applications • Applying the Frobenius method to solve di fferential equations arising in engineering applications • Visul izing Bessel and Legendre polynomials • Evaluat ing Fourier series -Harmonic series • Applying Z-Transforms to functions encountered in engineering • Solving Difference equations arising in engineering applications Application of the concepts to a minimum of 5 engineering problems f rom a common pool of problems • Report to be submitted in Digital format • Assessment on a continuous basis with a min of 3 reviews	L Hrs **30**	SLO

Textbooks:

1. Advanced Engineering Mathematics by Erwin Kreyszig, 10 t h Edition, John Wiley India, 2015.

Reference Books:

1. Higher Engineering Mathematics by B.S.Grewal , 42 nd Edition, Khanna Publishers, India, 2012.
2. Advanced Engineering Mathematics by Michael D. Greenberg, 2 nd Edition,Pearson Education, Indian Edition, 2006.

Mode of Evaluation	Digital Assignments (Solutions by using softs kill), Continuous Assessment Test Final Assessment Test
Recommended by the Board of Studies	05.06.2015
Date of Approval of Academic council**:**	**16.06.2015**
Compiled by	

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Course Code: MAT3003	COMPLEX VARIABLES AND PARTIAL DIFFERENTIAL EQUATION					
Pre-requisite: MAT2002		L	T	P	J	C
		3	1	0	0	4

Module	Topics	L Hrs	S LO
1	**Analytic Functions:** Complex variable-Analytic functions and Cauchy – Riemann equations - Laplace equation and Harmonic functions - Construction of Harmonic conjugate and analytic functions - Applications of analytic functions to fluid-flow and Field problems	6	1,2,7,9
2	**Conformal and Bilinear transformations:** Conformal mapping - Elementary transformations: translation, magnification, rotation, inversion, Exponential and Square transformations ($w = e^z$, z^2) - Bilinear transformation - Cross-ratio-Images of the regions bounded by straight lines under the above transformations	5	1,2,5,7,9
3	**Power series** - Functions given by Power Series - Taylor and Laurent series - singularities - poles - Residues	3	1,2,7,9
4	**Complex Integration** Integration of a complex function along a contour - Cauchy-Goursat theorem- Cauchy's integral formula -Cauchy's residue theorem - Evaluation of real integrals - Indented contour integral	5	1,2,7,9
5	**Partial Differential equations of first order** Formation and solution of partial differential equation - General, Particular, Complete and Singular integrals - Partial Differential equations of first order of the forms: F(p,q)=0, F(z,p,q)=0, F(x,p)=G(y,q) and Clairaut form - Lagrange's equation: Pp+Qq = R	6	1,2,7,9
6	**Partial Differential equations of higher order:**Solution of a partial differential equation by separation of variables - Linear partial differential equations of higher order with constant coefficients	6	1,2,7,9
7	**Fourier transforms:** Complex Fourier transform and properties - Relation between Fourier and Laplace transforms - Fourier sine and cosine transforms - Simple applications Boundary Value Problems- one dimensional wave equation-Fourier series solution	11	1,2,7,9
8	Expert lecturer-Applications of Fourier transforms and complex integration methods in Engineering problem	2	1,2,7,9 14,17
	Tutorial # A minimum of 5 problems to be worked out by students in every Tutorial Class #Another 5 problems per Tutorial Class to be given as home work.	15	1,2,7,9
	Total Lecture Hours	**45**	

Mode: Lectures Class room teaching
Introducing modules through applications

Text Book

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons (Wiley student Edison) (2011)

Reference Books

1. B. S. Grewal, Higher Engineering Mathematics, 42nd Edition (2013), Khanna Publishers, New Delhi
2. G.Dennis Zill, Patrick D. Shanahan, A first course in complex analysis with applications, 2nd Edition,

2013, Jones and Bartlett Publishers Series in Mathematics: Complex-
3. Michael, D. Greenberg, Advanced Engineering Mathematics, 2nd Edition, Pearson Education (2002)
4. Peter V. O' Neil, Advanced Engineering Mathematics, 7th Edition, Cengage Learning (2011)
5. JH Mathews, R. W. Howell, Complex Analysis for Mathematics and Engineers, Fifth Edition (2013), Narosa Publishers

Mode of Evaluation	Digital Assignments (Solutions by using softs kill), Continuous Assessment Test Final Assessment Test
Recommended by the Board of Studies	09-03-2016
Date of Approval of Academic council**:**	**18.03.2016**
Compiled by	Prof. K.Vijaya, Prof. K.Uma., Prof. T.Phaneedra, Prof. M.s.jagadeeshkumar, Prof. G.Murugusundaramoorthy

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Course Code: MAT3005	APPLIED NUMERICAL METHODS	L	T	P	J	C
Pre-requisite: MAT2002		3	1	0	0	4

Module	Topics	L Hrs	S LO
1	**Algebraic and Transcendental Equations:** General iterative method-Newton – Raphson method- Secant method -rates of convergence-System of non-linear equations-Newton's method	5	1,2,7
2	**System of Linear Equations and Eigen Value Problems:** Gauss –Seidel iteration method. Convergence analysis of iterative methods-LU Decomposition -Tri diagonal system of equations: Thomas algorithm- Eigen values of a matrix by Power and Jacobi methods	6	1,2, 11,18
3	**Interpolation:** Finite difference operators- Newton's forward-Newton's Backward- Central differences-Stirling's interpolation - Lagrange's interpolation - Newton's divided difference-Interpolation with cubic splines-Inverse Interpolation.	6	1, 2, 12,17
4	**Numerical Differentiation and Integration:** Numerical differentiation with interpolation polynomials-maxima and minima for tabulated values-Trapezoidal rule, Simpsons 1/3 rd and 3/8 th rules. –Romberg's method. Two and Three point Gaussian quadrature formula.	6	1, 2, 7,8
5	**Numerical Solution of Ordinary Differential Equations:** Taylor Series method-Runge – Kutta method of order four for first and second order differential equations- Adams-Bashforth-Moulton predictor-corrector methods. Finite difference solution for the second order ordinary differential equations.	8	1,2, 9,10
6	**Numerical solution of Partial Differential Equations:** Classification of second order linear partial differential equations-Laplace equation –Gauss-Seidal method-One dimensional heat equation- Schmidt explicit method-Crank-Nicolson implicit method.-One dimensional wave equation–Explicit method.	6	1, 2, 3,4
7	**Variational Methods:** Introduction to calculus of variations -Definition of functional - Extremals of functional of a single dependent variable and its first derivative: Rayleigh-Ritz method, Galerkin method.	6	1, 2, 17,18
8	**Guest Lecture by experts:** Finite element method for solving Differential equations.	2	1,2, 7,17
	Tutorial • A minimum of 5 problems to be worked out by students in every Tutorial Class • Another 5 problems per Tutorial Class to be given as home work.	15	5,6,8 13,15 20
	Total Lecture Hours	45	

Mode:

- Class room teaching
- Introducing Units through applications
- Min of 1 lecture by experts

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Textbooks:

1. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical methods for scientific and Engineering, New Age International Ltd., 5th Edition (2010).

2. C. F. Gerald and P.V. Wheatley. Applied Numerical analysis, Addition-Wesley, 7th Edition (2004).

Reference Books:

1. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI Pvt Ltd, 5th Edition, New Delhi (2009).

2. W.Y. Yang, W. Cao, T.S. Chung and J. Morris, Applied Numerical Methods Using MATLAB, Wiley India Edt (2007).

3. Steven C. Chapra and Ra P. Canale, Numerical methods for Engineers with Programming and software applications, 7th Edition, Tata McGraw Hill (2014).

4. R. L. Burden and J. D. Faires, Numerical Analysis, 4 th Edition, Brooks Cole, (2012).

Mode of Evaluation	Digital Assignments, Continuous Assessment Test Final Assessment Test
Recommended by the Board of Studies	09-03-2016
Date of Approval of Academic council**:**	**18.03.2016**
Compiled by	Prof. B.Rushi Kumar, Prof. R Hemmandri Reddy, Prof. Dr. B.S.R.V. Prasad Prof. Dr. Nageshwar Rao Ragi, Prof. Dr. Peri Kameswara Kameswaran

Course Code: MEE1001	ENGINEERING DRAWING					
Pre-requisite: Nil		L	T	P	J	C
		1	0	4	0	3

Module	Topics	L Hrs	S LO
1	**Lettering and Dimensioning:** Introduction, lettering practice, Elements of dimensioning - systems of dimensioning.	1	6, 17
2	**Geometric Constructions:** Free hand sketching, Conic sections, Special curves.	2	6, 17
3	**Projection of Points:** First and Third Angle Projections; Projection of points. **Projection of Lines:** Projection of straight lines (First angle projection only); Projection of lines inclined to one plane and both planes, true length and true inclinations.	3	6, 17
4	**Projection of solids:** Classification of solids, Projection of solids in simple position, Projection of solids inclined to one plane. **Sections of Solids:** Right regular solids and auxiliary views for the true shape of the sections.	4	5, 6, 17
5	**Development of Surfaces:** Development of surfaces for various regular solids.	2	5, 6, 17
6	**Isometric Projection:** Isometric scales, Isometric projections of simple and combination of solids. **Perspective Projection:** Orthographic representation of a perspective views – Plane figures and simple solids - Visual ray method.	2	5, 6, 17
7	**Orthographic Projection:** Conversion of pictorial view into orthographic Projection.	1	5, 6, 17
	Total Lecture Hours	15	

 # Mode: Flipped Class Room, Video Lectures.

Text Books

1. Venugopal K and Prabhu Raja V, "Engineering Graphics", New AGE International Publishers, 2015.

References

1. N. D. Bhatt, Engineering Drawing, Charotar publishing House, 2012.
2. Natarajan, K. V., A Text book of Engineering Graphics, Dhanalakshmi Publishers, 2009.

Lab Exercises	Hours	SLO
1. Identifying the wrong dimensioning and correct it as per BIS standards 2. Tutorials on free hand sketching and geometric constructions like conics and special curves 3. Representation of orthographic projection of points 4. Representation of orthographic projection of lines (First angle projection only) inclined to one plane and projection of lines inclined to both the planes 5. Sketching orthographic projection of solids in simple position and projection of solids inclined to one plane. 6. Drawing the auxillary views, orthographic views and true shape of sectioned regular solids	60	17

7. Development of lateral surfaces of the regular shapes and sectioned shapes 8. Conversion of orthographics views to isometric views 9. Tutorial problems on perspective projection of plane figures and simple solids 10. Conversion of pictorial drawing into orthographic projection Experiments are to be done on both manual and CAD tool. Examination and evaluation is to be done separately for manual and CAD and marks are combined.		

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT
Recommended by the Board of Studies	**10.06.2015**
Date of Approval of Academic council**:**	**16.06.2015**
Compiled by	Dr. Jegadeeshwaran Dr. A. Ananda Babu Dr. E. Rajkumar

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Course Code: MEE1003	ENGINEERING THERMODYNAMICS	L	T	P	J	C
Pre-requisite : NIL		2	1	0	0	3

Module	Topics	L Hrs	SLO
1	**Basic Concepts in Thermodynamics**: Basic concepts of Thermodynamics - Thermodynamics and Energy - Closed and open systems - Properties of a system - State and equilibrium - Processes and cycles - Forms of energy - Work and heat transfer - Temperature and Zeroth law of thermodynamics -	4	1, 2, 9, 11
2	**First law of thermodynamics** - Energy balance for closed systems - First law applied to steady – flow engineering devices.	3	1,2,5,9
3	**Second Law of Thermodynamics:** Limitations of the first law of Thermodynamics - Kelvin-Planck and Clausius statements and its equivalence- Refrigerators, Heat Pump–COP - Perpetual Motion Machines - Reversible and Irreversible process Carnot's Theorem - Entropy - The Clausius inequality -	4	1,2,5 9
4	**Concept of Exergy-** Availability and irreversibility - Second law efficiency- Quality of Energy	2	1,2.5,9
5	**Properties of pure substance-** Property diagram for water-phase change processes-refrigerants-real gases-Compressibility factor	3	1,2
6	**Thermodynamic relations-**Gibbs and Helmholtz function-Maxwell's relations-Clapeyron equations-general relations of properties	4	1,2
7	**Gas power cycles**- Air standard assumptions - Otto cycle - Diesel and Dual cycles - Brayton cycle	3	1, 2, 5, 11
8	**Vapor and Refrigeration Cycles-** Rankine cycle-reheat-regeneration-Vapor compression refrigeration cycle	4	1, 2, 5, 11
9	**Ideal Gas Mixtures**: Composition of gas mixtures - Mass and mole fractions - Dalton's law of additive pressures - Amagat's law of additive volumes - Evaluating properties of gas mixtures	3	1, 2,5, 9
	Total Lecture Hours	30	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Industrial Visit, challenging assignments, minimum of 2 guest lectures by industry experts.			
Tutorial # A minimum of 5 problems to be worked out by students in every Tutorial Class. Another 5 problems per Tutorial Class to be given as home work. At least one open ended design problem to be given. # **Mode**: Individual Exercises, Team Exercises, Online Quizzes, Online Discussion Forums		15	1, 2, 9,

Text Books

1. Yunus A. Cengel, (2011), Thermodynamics: An Engineering Approach, TataMcGraw- Hill Publishing Company Ltd.

Reference Books

1. P. K. Nag, (2009), Basic and Applied Thermodynamics, Tata McGraw-Hill Publishing Company Ltd.
2. Michael Moran and Howard Shapiro, (2010), Fundamentals of Engineering Thermodynamics, John Wiley and Sons

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT

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Recommended by the Board of Studies on:	10.6.15
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Dr. Manavalla Srikanth Prof. M. Senthil Kumar Prof. E. Porpatham

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Course Code: MEE1004	FLUID MECHANICS					
Pre-requisite : NIL		L	T	P	J	C
		2	1	2	0	4

Module	Topics	L Hrs	SLO
1	**Introduction to Fluid Statics** Definition of Fluid, Concept of Continuum, Fluid Properties, Classification of Fluids, Pascal's and Hydrostatic Law, Pressure and its Measurement.	2	1, 2, 9, 11
2	**Hydrostatic Forces and Buoyancy** Hydrostatic forces on Plane – Inclined and Curved surfaces – Buoyancy – Condition of Equilibrium for Submerged and Floating Bodies- Centre of Buoyancy – Metacentre-Determination of Metacentric Height.	4	1, 2, 9, 11
3	**Fluid Dynamics** Types of flows, Control Volume, Reynolds Transport Theorem, Continuity, Euler and Bernoulli's equations Momentum equation-Navier-Stokes Equations-Applications.	4	1,2,6,9,11
4	**Flow Through Pipes** Measurement in pipe flow-Major loss – Minor losses – Multi reservoir problems – pipe network design – Moody's diagram – Hagen Poiseuille equation – Turbulent flow.	4	1,2,6,9,11
5	**Open Channel Flow** Types of open channel flows - Specific Energy – Specific force - Critical flow - Hydraulic jumps/Surges and gradually varying flow concepts – Measurement of discharge in open channels.	5	1,2,6,9,11
6	**Dimensional Analysis** Dimensional homogeneity – Raleigh and Buckingham p theorems – Non-dimensional numbers – Model laws and distorted models-Modelling and Similitude.	5	1,2,6,9,11
7	**Boundary Layers** Boundary layers – Laminar flow and Turbulent flow – Boundary layer thickness – momentum – Integral equation – Drag and lift-Separation of boundary layer-Methods of separation of boundary layer	6	1,2,6,9,11
Total Lecture Hours **# Mode:** Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Industrial Visit, challenging assignments, minimum of 2 guest lectures by industry experts.		**30**	
Tutorial # A minimum of 5 problems to be worked out by students in every Tutorial Class. Another 5 problems per Tutorial Class to be given as home work. At least one open ended design problem to be given. # **Mode**: Individual Exercises, Team Exercises, Online Quizzes, Online Discussion Forums		**15**	1, 6, 9,11

Text Books

1. Philip J. Pritchard and John W. Mitchell (2015), "Fox and McDonald's Introduction to Fluid Mechanics", 9th Edition, John Wiley & Sons.
2. Dr.R.K. Bansal (2015), "A Text Book of Fluid Mechanics and Hydraulic Machines", 9th Edition, Laxmi Publication.

References

1. Dr. P.N. Modi and S.M. Seth (2011), "Hydraulics and Fluid Mechanics Including Hydraulic Machines", 18th Edition, Standard Book House.
2. Pijush K. Kundu, Ira M. Cohen and David R. Dowling (2012), "Fluid Mechanics", 5th Edition, Academic Press.
3. Yunus A. Cengel and John M. Cimbala, "Fluid Mechanics – Fundamentals and Applications", 3rd Edition, McGraw Hill Publishers.
4. Frank M. White (2015), "Fluid Mechanics", 8th Edition, McGraw Hill Publishers.
5. Dr. A.K. Jain (2008), "Fluid Mechanics", Khanna Publishers.
6. Donald F. Elger, Barbara C. Williams, Clayton T. Crowe, John A. Roberson (2013), "Engineering Fluid Mechanics", 10thEdition, John Wiley & Sons.
7. V.L. Streeter (2010), "Fluid Mechanics", McGraw Hill Book Co.

Lab Exercises	Hours	SLO
1. Flow through Orifice a) Constant Head Method b) Variable Head Method 2. Flow through Mouth Piece a) Constant Head Method b) Variable Head Method 3. Flow through Rectangular Notch 4. Flow through Triangular Notch 5. Verification of Bernoulli's Theorem 6. Metacentric Height for a Ship Model 7. Determination of Major Loss in a Single Pipe Flow 8. Determination of Major Loss in an Annular Double Pipe Flow 9. Determination of Minor Losses in a Pipe Flow 10. Flow through Venturimeter and Orificemeter 11. Determination of Specific Energy in a Rectangular Channel Flow – Tilting Flume Experiment 12. Demonstration of Reynolds Experiment – Determine the state of flow 13. Demonstration of Wind Tunnel – Measurement of lift and drag of an aerofoil	15	14

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT
Recommended by the Board of Studies on:	10.6. 2015
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Dr. Shyam Dr. A. Satheesh

Course Code: MEE1005	MATERIALS ENGINEERING AND TECHNOLOGY					
Pre-requisite: NIL		L	T	P	J	C
		2	0	2	4	4

Module	Topics	L Hrs	SLO
1	**Structure of Materials** Introduction to engineering materials – significance of structure property correlations in all classes of engineering materials, Unit Cells, Metallic Crystal Structures, Density Computations, Crystal Systems, Crystallographic Points, Crystallographic Directions, Crystallographic Planes, Linear and Planar Densities, Close-Packed Crystal Structures, Crystalline and Non-crystalline Materials, Single Crystals, Polycrystalline Materials, Imperfection in solids – Point, Line, Surface and Volume defects - Polymorphism and Allotropy	7	1, 2
2	**Constitution of Alloys** Mechanism of Crystallization- Nucleation-Homogeneous and Heterogeneous Nucleation- Growth of crystals- Planar growth – dendritic growth – Cooling curves - Diffusion - Construction of Phase diagram -Binary alloy phase diagram – Cu-Ni alloy; Cu-Zn alloy and Pb-Sn alloy; Iron-Iron carbide phase diagram – Invariant reactions – microstructural changes of hypo and hyper-eutectoid steel- TTT and CCT diagram	6	1,2
3	**Heat Treatment and Surface Heat treatment** Heat treatment – Overview – Objectives – Annealing and types, normalizing, quenching, austempering and martempering – microstructure changes – Surface hardening processes - Carburizing –, nitriding – cyaniding and carbonitriding, induction and flame hardening, Laser and Electron beam hardening– principles and case depths	4	2,5,6
4	**Ferrous and Non-ferrous metals** Steels – Types of Steels - White, Grey, Malleable and Nodular - Properties and application of cast irons, Effect of alloying elements on structure and properties of steels - Properties and uses of Silicon and Hadfield Manganese steels, High speed steels - Stainless steel and Types - Non Ferrous metals - Aluminum, Magnesium, Copper, Nickel, Titanium and their alloys	4	1,2
5	**Mechanical behavior of Materials** Strengthening mechanisms – Hardness measurements – Tensileproperties of the materials – Fracture of metals – Ductile Fracture, Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT) –Fatigue – Endurance limit of ferrous and non-ferrous metals -Fatigue test, S-N curves, factors affecting fatigue, structural changes accompanying fatigue; Creep and stress rupture– mechanism of creep – stages of creep and creep test	5	2,5,6
6	**Introduction to Advanced Materials** Properties and Applications of Engineering polymers- Ceramics – properties and applications of various ceramics – Composites – and their types; properties and processing of composites – Manufacture of fibres	4	1
	Total Lecture Hours	**30**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Industrial Visit, challenging assignments, minimum of 2 guest lectures by industry experts.

Practical 1. Overview of Materials Characterization – Optical Microscopy, Scanning Electron Microscopy, X-Ray Diffraction and Energy Dispersive X-ray analysis 2. Perform the metallographic studies and identify the given steel samples. 3. Perform the metallographic studies and identify the given cast iron samples 4. Conduct the metallographic examination on the given non-ferrous samples 5. Design the heat treatments that result in the following microstructures (a) Coarse pearlite (b) Medium/Fine pearlite (c) 100% Martensite (d) Martensite and retained austenite 6. Perform the hardness examination on the given samples using Rockwell Hardness Tester and find out the equivalent Vickers hardness in HV. 7. Conduct the tensile studies on the given sample and infer whether the given sample is ductile or brittle. Evaluate the elastic and plastic properties of the given sample. 8. Perform the high cycle fatigue on the given standard sample. Report the inference. 9. Use metallographic analysis software to establish the phases and average grain size of the given samples. 10. Demonstration on the development of composites	30	2,6,9, 13,14 and 17
Project # Generally a team project of Five # Concepts studied in Modules 2, 4, 5 should have been used # Down to earth application and innovative idea should have been attempted Sample projects such as 1. How to identify the given unknown sample? What are the metallurgical and mechanical tests to be conducted to assess the properties of the sample? 2. A fractured sample is given for assessment to interpret the reasons for fracture. What are the various metallurgical tests to be carried out to infer the same? 3. Design a sub-sized sample as per ASTM standard. Conduct the tensile test and assess the tensile properties. Comment on the sample on its character. 4. Immerse the given sample in 3.5% NaCl solution to study the corrosion after 100 hours. Study the microstructure and phases present using optical microscopy and XRD 5. Compare the microstructures of the given steel sample before and after heat treatment. Also measure the hardness of the samples 6. Design and fabricate the sample for conducting fatigue test. Conduct the high cycle fatigue and estimate the service life time. 7. Perform high temperature corrosion studies on the given sample at 500°C in air oxidation and analyze the microstructure before and after corrosion 8. Perform a stress-relieving heat treatment on the welded samples. How do you ensure the stresses are relieved? 9. Conduct the corrosion studies on the given sample using electrochemical cell. What is the inference drawn from the polarization curves? 10. Perform XRD analysis on the heat treated samples and identify the phases. 11. Perform the metallographic examination on the given sample and determine the ASTM grain size number. 12. Design a heat treatment for the steel that results in microstructure that contains pearlite and martensite. Also investigate the hardness and compare it with the fully quenched sample.	**60** [Non Contact hrs]	5,9,14 and 17

13. Perform a simple arc welding on the given samples. Identify the microstructure at different zones of interest. 14. Prepare the ASTM sub-sized sample for conducting the impact test. Find out the mode of fracture using SEM analysis. # Assessment on a continuous basis with a min of 3 reviews.		

Text Books

1. W.D. Callister, David G. Rethwisch, (2010) Materials Science and Engineering: An Introduction, 8th ed., Wiley & Sons

Reference Books

1. Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright (2010), The Science and Engineering of Materials 6th Edition, Cenage Publications
2. William F. Smith and Javad Hashemi (2006), Foundations of Materials Science and Engineering 5th Edition, McGraw Hill.
3. Sidney H Avner, (2008) "Introduction to Physical Metallurgy, 2nd Edition, Tata McGraw Hill Publishing Company Limited
4. ASM Handbook, Metallography and Microstructure, ASM International, Volume 9, 2004
5. Jon L. Dossett, Howard E. Boyer (2006),Practical Heat Treating: 2nd Edition, ASM International.

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT
Recommended by the Board of Studies on:	10.6.2015
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Dr. K. Devendranath Ramkumar Dr. Pankaj Balkrishna Tambe Dr. U. Narendra Kumar Dr. A. Raja Annamalai Dr. S.K. Ariful Rahaman

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Course Code: MEE1007	MANUFACTURING PROCESSES	L	T	P	J	C
Pre-requisite: NIL		2	0	2	0	3

Module	Topics	L Hrs	SLO
1	**Manufacturing** Manufacturing- The Role of Manufacturing Development in the growth of a country –Classification of manufacturing processess **Casting processes** Casting: Fundamentals of metal casting –Pattern and mould making- Different casting techniques-Melting practice and furnaces - Defects in casting – Testing and inspection of casting.	6	17
2	**Joining Processes** Fusion welding processes-Solid state welding processes-Advanced welding techniques-Weld quality – Testing welded joints.	6	17
3	**Metal forming Processes** Cold and Hot working-Bulk metal forming -Sheet metal forming – High Energy Rate Forming Processes: Explosive Forming – Electro Hydraulic Forming – Electro Magnetic Forming.	6	17
4	**Processing of Powder Metals, Ceramics, Glass and Plastics** Powder metallurgy- Shaping of ceramics-Glass-Processing of plastics: Injection molding – Blow molding – Compression molding – Transfer molding – Thermoforming.	6	17
5	**Process selection** Systematic process selection-Process selection charts-Ranking process cost-Cost modelling **Case studies** Aluminum Connecting Rod, Fan leaf with nylon material, Airbag canisters, Joining a Steel Radiator, Car bonnet, Spark Plug Insulators, Ceramic knife, Devices to open corked bottle, Aircraft wing spar, Forks for a racing bicycle, Spark plug insulator, Insulation for refrigerator,etc.	6	6,17
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Industrial Visit, challenging assignments, minimum of 2 guest lectures by industry experts.			
Lab: 1. Plaster mould casting- Create a mould for slip casting of the given component using suitable material and fabricate the component using slurry casting technique 2. Metal casting: Preparation of Green sand mold using different levels of moisture content. 3. Join the given GI pipes as per the diagram and make it leak proof for supply of water. 4. Arc welding – Join the given thick metal sheets using suitable welding process. The weld finish quality is not a constrain. 5. TIG welding: Prepare the TIG weldment of steel with 316 stainless steel.Find out the efficiency of the weldment by tensile test 6. Make a Tray as per the given dimensions using sheet metal. The corners of the	**30**	**6,17**

tray has no leack proof constraint. 7. Identify the thickness variation of a sheet metal bend sample for different loading conditions and observe the changes in microstructure using optical microscope. 8. Finding the stress level of the sheet metal component before and after annealing 9. To find the Green Density & Strength (hardness) of Cold-compacted/sintered metal powder 10. Carpentry Dove tail joint: Join the given two wooden slabs perpendicular to each other in their longer edges by selecting suitable joint which gives maximum strength. 11. Make an wooden book stand without doors using suitable joints. 12. Demonstration of pouring the Non Ferrous Metal by using Crucible Tilting Furnace 13. Finding out the optimum method of producing a WC tool. **Evaluation mode: Marks distribution for:** **(i) selection of suitable process/materials** **(ii) completion and finishing quality of the exercise** **(iii) viva & record**		

Text Books

1. Serope Kalpakjian; Steven R. Schmid (2010), Manufacturing Engineering and Technology, 6th Edition, Publisher: Prentice Hall, ISBN-10 0-13-608168-1, ISBN- 13 978-0-13-608168-5
2. P.N.Rao. (2009), Manufacturing Technology – Foundry, Forging and Welding, Tata McGraw Hill Publishing Company Ltd., New Delhi.

Reference Books

1. S.Kalpakjian and S.R.Schmid, (2004), Manufacturing Engineering and Technology, 4th Edition, Pearson Education (Singapore) Pte Ltd.
2. P.N.Rao. (1998), Manufacturing Technology – Foundry, Forging and Welding, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Hajra Choudhury S.K. (2004), Elements of Manufacturing Technology, Vol. - I, Media Publications.

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT
Recommended by the Board of Studies on:	10.6.2015
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Dr. Jafferson Dr.C. Pandivelan Dr. Jacob Varghese

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Course Code : MEE2001	MACHINE DRAWING	L	T	P	J	C
Pre-requisite : MEE1001		1	0	2	4	3

Module	Topics	L Hrs	SLO
1	**Basics of Machine Drawing:** Introduction – Projections - Classifications of machine drawing- BIS specifications - Sectioning –Dimensioning methods: Counter Sink, Counter Bores, Spot Faces, Chamfers, Screw Threads, Tapered Features, Title block of Industrial drawing and Bill of Materials.	4	1,4,5
2	**Limits and Fits:** Classifications and of Fits, Selection of Fits, Representation on Drawings, Tolerance Grade, Computations of Tolerance, Positions of Tolerance, Fundamental of Deviations, Shaft and Hole Terminology, Method of placing limit dimensions.	2	1,4,5
3	**Geometrical Tolerances:** Need of Geometrical Tolerance, Geometrical Characteristics of Symbols, Indication of MMC, LMC, Interpretation and Indication of Geometrical Tolerance and Dimensioning.	2	1,4,5
4	**Conventional Representations:** Materials - Interrupted views and Braking of Shaft, Pipe, Bar - Surface finishing & Machining Symbols.	2	1,4,5,6, 11,17
5	**Screwed Fastenings and Joints:** Screwed Fastenings - Screw Thread Nomenclature and types, Joints: Bolts and Nuts, Key, Cotter, Riveted, Pin, Welded joints. Pulleys and Couplings.	3	1,4,5,6, 11,17
6	Contemporary Discussion	2	2
	Total Lecture Hours		
	# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Industrial Visit, challenging assignments, minimum of 2 guest lectures by industry experts.	**15**	
	Laboratory Laboratory: Minimum Seven exercises using CAD solid modeling software. For each exercise, 3D part modeling, Detailing and Assembly have to be submitted. 1. 3D Modeling, assembly and detailing of joints. 2. 3D Modeling, assembly and detailing of couplings. 3. 3D Modeling, assembly and detailing of bearings. 4. 3D Modeling, assembly and detailing of valves. 5. 3D Modeling, assembly and detailing of automotive components. 6. 3D Modeling, assembly and detailing of machine elements. **7.** 3D Modeling, assembly and detailing of manufacturing components.	**30**	1, 5, 6, 17
	Project: Project work of their choice like new product design/design improvement of existing product. The project content should have innovation and novelty in concepts. It is essential to apply the knowledge gained in this course and incorporate them in the project. The project report should consists of inidvidual part drawing, assembly drawing and final production drawing. Final project report has to be submitted at the end the course. Guidelines for Project: • The project will be a group project with a maximum of 3 members in a group. The size will reflect the complexity of the project. Students should make sure that the concepts to be studied are reflected in the project and that there is an innovative component .	**60** [Non-contact Hours]	1, 4, 5, 6, 11, 17, 18

• There will be a minimum of three reviews conducted in a semester and the marks will be awarded and taken for final assessment. The marks distribution for 3 reviews will be 20:30:50. • Minimum pass marks for project is 50%. If the student fails to get 50%, he/she has to re-register and redo in a subsequent semester. • If the student has got >= 50% in project, and fails in Theory, then the same marks can be taken up for grading purposes after he/she completes the Theory FAT. • Evaluation is through continuous assessment with 3 reviews. No separate FAT. **Sample Project**: • Design and drafting of double wishbone suspension system for a passenger car. • Design of five point toggle clamp for a plastic injection molding machine. • Design of final drive assembly for an automobiles.		

Text Book

1. Bhatt, N.D. (2014), Machine Drawing , Published by R.C.Patel, Chartstar Book Stall, Anand, India.

References Books

1. Ajeet Singh (2012), Machine drawing, Tata McGraw Hill, 2nd edition.
2. Brain Griffiths (2003), Engineering Drawing for manufacture, Kogan page science,USA.
3. N.D.Junnarkar. (2004), Machine Drawing, Pearson education, 1st edition.

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT
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Compiled by	Prof. A. Ananda Babu Prof. K. Annamalai

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Course Code : MEE2002	STRENGTH OF MATERIALS	L	T	P	J	C
Pre-requisite : MEE1002		2	1	2	0	4

Module	Topics	L Hrs	SLO
1	**Simple Stresses and strains:** Definition/derivation of normal stress, shear stress and normal strain and shear strain – Stress-strain diagram for brittle and ductile materials - Poisson's ratio & volumetric strain – Elastic constants – relationship between elastic constants and Poisson's ratio – Generalised Hook's law – Deformation of simple and compound bars – Strain energy – Resilience – Gradual, sudden, impact and shock loadings – thermal stresses.	4	1,2,5,14
2	**Bi-axial Stress system:** Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses – Principal stresses and strains – Analytical and graphical solutions, Theories of Failure.	4	1,9,11,18
3	**Shear Force and Bending Moment:** Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.	4	1,2,5,9
4	**Stresses in beams:** Theory of simple bending – Assumptions – Derivation of bending equation - Neutral axis – Determination of bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections – Design of simple beam sections, Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.	4	1,2,5,12
5	**Deflection of beams:** Deflection of beams by Double integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams – Conjugate beam method.	4	1,5,7,9, 17,18
6	**Torsion:** Introduction to Torsion – derivation of shear strain – Torsion formula – stresses and deformations in circular and hollow shafts – Stepped shafts – shafts fixed at the both ends – Design of shafts according to theories of failure, Stresses in helical springs.	4	1,5,9,11, 18
7	**Columns:** Theory of columns – Long column and short column - Euler's formula – Rankine's formula. **Thin and thick cylinders:** Thin cylinders and shells – deformation of thin cylinders and shells – thick cylindrical shell – Lame's equation.	4	1,9,17,18
8	**Contemporary Discussion**	2	2
Total Lecture Hours # **Mode:** Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Industrial Visit, challenging assignments, minimum of 2 guest lectures by industry experts.		**30**	
Tutorial Tutorial class for Module 1 (3 hours) Tutorial class for Module 2 (1 hour)		**15**	1,2,7,9, 12,17,18, 19

Tutorial class for Module 3 (2 hours) Tutorial class for Module 4 (2 hours) Tutorial class for Module 5 (2 hours) Tutorial class for Module 6 (2 hours) Tutorial class for Module 7 (2 hours) Tutorial class for Module 8 (1 hour) # A minimum of 3 problems to be worked out by students in every tutorial class. Another 6 problems per Tutorial Class to be given as home work. # **Mode**: Individual Exercises, Team Exercises, Online Quizzes, Online Discussion Forums, Assignments		
Laboratory 1. Evaluation of Engineering Stress/Strain diagram on different materials (ductile and brittle) and different shapes in geometry (bars and flat) under tension. 2. Comprehension of different cross sections of beam on bending stress. 3. Deflection test – Verification of Maxwell theorem. 4. Comparison of hardness values of Steel, Copper and Aluminium using Rockwell, Brinell and Vickers hardness measuring machines. 5. Estimation of Spring constant under Tension and Compression. 6. Estimation of Notch Toughness of Steel using Charpy and Izod Impact Testing Machines. 7. Torsion Test on Mild Steel Rod. 8. Double shear test in U.T.M. 9. Fatigue test on Steel. 10. Strain measurement using Rosette Strain Gauge. 11. Tensile strength of welded joints using UTM. 12. Load measurement using Load indicator and Load coils.	**30**	1, 2, 4, 5, 6, 7, 14

Text Book

1. Ferdinand Beer, Russell Johnston, John T DeWolf (2009), Mechanics of Materials, Tata McGraw-Hill Education.

Reference Books

1. Rowland Richards (2000), Principles of Solid Mechanics, CRC Press.
2. Timoshenko, S.P. and Young, D.H. (2000), Strength of Materials, East West Press Ltd.
3. W. A. Nash and M. C. Potter (2011), Strength of Materials, Fifth Edition, Schaum's Outline Series, McGraw-Hill.
4. R.K. Bansal (2010), Strength of Materials, Laxmi Publications.

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT
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Compiled by	Prof. G. Venkatachalam Prof. Christo Michael

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Course Code : MEE2003	THERMAL ENGINEERING SYSTEMS	L	T	P	J	C
Pre-requisite : MEE1003		2	1	2	0	4

Module	Topics	L Hrs	SLO
1	**IC Engines** – Working principle of 2 stroke and 4 stroke SI and CI engines with PV and Valve Timing Diagrams, Combustion process - Knocking and detonation, Cetane and Octane numbers, Comparison of fuel system of diesel and petrol engines, Cooling system, Lubrication system, Ignition system - Battery, Magneto and Electronic systems.	4	1, 2, 5
2	**IC Engines Performance** – Performance test - Measurement of Brake power, Indicated power, Fuel consumption, Air consumption; Heat balance test, Morse test and Retardation test on IC engine.	4	1, 2, 9
3	**Steam Boilers** – Types of boilers, Reheating - Regeneration - Modern features of high-pressure boilers - Heat Recovery Boilers - Mountings and Accessories. Steam Nozzles – One-dimensional steady flow of steam through a convergent and divergent nozzle.	4	1,2, 9
4	**Steam Turbine** – Impulse and Reaction principle. **Gas Turbine** – Open and Closed cycle gas turbine, Reheating, Regeneration and Intercooling.	4	1, 2, 9
5	**Positive Displacement Compressors** – Reciprocating compressors - Construction - Working - Effect of clearance volume – Multi-staging - Volumetric efficiency - Isothermal efficiency.	4	1, 2, 5, 9
6	**Refrigeration** – Vapor compression system - Components - Working - P-H and T-S diagrams - Calculation of COP - Effect of sub-cooling and super-heating - Vapor absorption system - NH_3 - water system, Vapor adsorption system. **Cryogenic engineering:** Introduction, Application, Cryo-coolers	4	1,2, 9
7	**Air-conditioning** – Types, Working Principles - Psychrometry, Psychrometric chart, cooling load calculations.	4	1, 2, 5, 9
8	**Contemporary Discussion**	2	2
	Total Lecture Hours		
	# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Industrial Visit, challenging assignments, minimum of 2 guest lectures by industry experts.	**30**	
	Tutorials Tutorial class for Module 1 (3 hours) Tutorial class for Module 2 (2 hours) Tutorial class for Module 3 (2 hours) Tutorial class for Module 4 (2 hours) Tutorial class for Module 5 (2 hours) Tutorial class for Module 6 (2 hours) Tutorial class for Module 7 (2 hours)	**15**	1,2,9
	Laboratory 1. Compare the performance of a single cylinder CI engine connected with different dynamometers and suggest a suitable dynamometer for better accuracy of the results. 2. Compare the energy distribution of a single cylinder CI engine connected with different dynamometers and suggest a suitable dynamometer for better accuracy of the results.	**30**	1,2,14,18

3. Do the performance test on a single cylinder SI engine and compare your results with the engine specifications. Suggest a suitable method to improve the accuracy of your results. 4. Determine the friction power of a given four cylinder petrol engine by performing Morse test and compare the results with Willian's line method. 5. Determine the friction power of a given single cylinder diesel engine by performing retardation test and compare the results with Willian's line method. 6. Compare the properties of different fuels by performing flash point, fire point, viscosity and calorific value tests and find out which is suitable for the better performance of the given engine. 7. Determine the actual index of compression and compare with the isentropic compression for a given reciprocating air compressor. 8. Compare the performance of air blower with different vane profiles. 9. Calculate the COP of the given vapor compression refrigeration system and compare with your theoretical calculation. 10. Calculate the COP of the given air-conditioning test rig and compare with your theoretical calculation. 11. Compare the boiler efficiency for different load levels for the given boiler. 12. Compare the power output for the steam turbine at different load conditions. 13. Draw the valve timing and port timing diagrams for the given engines, compare with the theoretical value and give your comments.		

Text Book

3. Rajput R.K (2010), Thermal Engineering, Eighth Edition, Laxmi Publications(P) Ltd.

Reference Books

1. Mathur.M.L & Sharma R.P (2009), Internal Combustion Engine, Dhanpat Rai Publications.
2. Manohar Prasad (2007), Refrigeration and Air Conditioning, New Age International.
3. Soman.K (2011), Thermal Engineering, PHI Learning Private Ltd.

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. K. Nanthagopal Prof. R. Sivakumar

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Course Code : MEE2004	MECHANICS OF MACHINES	L	T	P	J	C
Pre-requisite : MEE1002		2	1	0	4	4

Module	Topics	L Hrs	SLO
1	**Basics of Mechanisms:** Introduction- Terminologies, Degree of Freedom – Study of planar mechanisms and their inversions.	3	1,2,4,6
2	Velocity and accelerations in planar mechanisms, Coriolis component of acceleration.	4	1,2,4,6
3	**Kinematics of Cams:** Cams with different Follower Motion. **Kinematics of Gears and Gear trains:** Gear terminologies- Law of gearing- Interference and undercutting- Epicyclic gear train.	4	1,2,4,6
4	**Synthesis of mechanisms:** Two position and Three position synthesis of planar mechanism – Graphical and analytical methods – Freudentein equation.	4	1,2,4,6
5	**Dynamic Force Analysis:** D'Alembert's Principle, Dynamic Analysis of planar Mechanism. Turning Moment Diagrams – Flywheels – Applications.	4	1,2,4,6
6	**Balancing:** Static and Dynamic Balancing of Rotating masses, Balancing of Reciprocating masses. **Vibration:** Introduction – Terminologies- Single degree of freedom- damped and undamped free and forced vibration.	4	1,2,4,6
7	**Mechanisms for Control:** Governors- types and its characteristics. **Gyroscope** – Gyroscopic Effects on the Movement of airplanes and Ships – Gyroscope Stabilization.	5	1,2,4,6
8	**Contemporary Discussion**	2	2
	Total Lecture Hours		
	# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Industrial Visit, challenging assignments, minimum of 2 guest lectures by industry experts.	**30**	
	Tutorials Tutorial class for Module 1 (2 hours) Tutorial class for Module 2 (3 hours) Tutorial class for Module 3 (2 hours) Tutorial class for Module 4 (2 hours) Tutorial class for Module 5 (2 hours) Tutorial class for Module 6 (2 hours) Tutorial class for Module 7 (2 hours) # A minimum of 3 problems to be worked out by students in every tutorial class. Another 6 problems per Tutorial Class to be given as home work. # **Mode**: Individual Exercises, Team Exercises, Online Quizzes, Online Discussion Forums, Assignments	**15**	1,2,6,9
	Project • Generally a team project [Maximum of 4 members only] • Concepts studied should have been used. • Down to earth application and innovative idea should have been attempted. • Report in Digital format with all drawings using software package to be submitted. • Assessment on a continuous basis with a minimum of 3 reviews.	**60** [Non-Contact Hours]	2, 6, 9, 11, 16, 17, 18

1. Radius of gyration effect in machine components:
    - Connecting rod,
    - Shaft with gears at two end,
    - Automotive cam shaft.
2. Simulation software
    - Velocity, acceleration and jerk analysis of different cams.
    - Analysis of epicylic gear trains.
    - Analysis of planar mechanism - windshield wiper mechanism.
    - Ackerman steering mechanism.
    - Automotive differential drive system.
    - Analysis of planar mechanism – slider crank mechanism of an IC engine, manual water pump etc.,
    - Analysis of planar mechanism – Power window mechanism in an automobile.
    - Analysis of planar mechanism – Robot joints.
    - Kinematic and dynamic analysis of construction machinery like backhoe loader, bucket elevator etc.,
3. Real time analysis of quick return mechanism in a shaping machine, slotting machine.
4. Development of punching press for book binding application.
5. Develop a mechanism to crush aluminium foil tin- Validation of real time model with software.
6. Effect of balancing for vibration reduction in mechanical systems.
7. Modal analysis of composite beams and plates – Applications in aerospace and automotive industry
    - Natural fiber reinforced composite materials,
    - CNT reinforced composite materials,
    - Sandwich materials.
8. Modal analysis of an engine assembly and mechanical systems- Validation of computer models with real time data.
9. Development of a base exciter table for testing small machine/electronic components using cam mechanism.
10. Effect of damper in automatic door closure mechanism.
11. Effect of viscous damping on torsional vibration characteristics of an automotive gear assembly.
12. Develop a mechanism for automatic page turner to assist a quadriplegic patient.
13. Design and development of a mechanism for pick and place application in automotive assembly line.
14. Design and development of a mechanism for bottle filling application in a beverage industry.
15. Develop a mechanism for package industry for automatic accurate packing of namkeens.
16. Develop a mechanism for balancing bicycle wheels.
17. Design and development of coin sorting mechanism.
18. Applications of governor
    - Hydraulic fluid flow control
    - Vehicle speed control

Text Book

1. S. S. Rattan (2012), Theory of Machines, Tata McGraw Hill.

Reference Books

1. A. Ghosh and A. K. Mallick (2006), Theory of Mechanisms and Machines, East-West Press Pvt. Ltd.
2. Kenneth J Waldron, Gary L Kinzel and Sunil Agarwal (2016), Kinematics, Dynamics and Design of Machinery, John-Wiley and Sons.
3. A.G.Ambekar (2007), Mechanism and Machine Theory, Prentice Hall of India.
4. R.L.Norton (2003), Design of Machinery, Tata McGraw Hill.
5. Thomas Bevan (2010), Theory of Machines, Pearson Education Publishers.
6. William T Thomson, Marie Dillon Dahleh and Chandramouli Padmanabhan (2008), "Theory of Vibration with applications", Fifth Edition, Pearson Education Publishers.
7. John J Uicker, Jr., Gordon R Pennock and Joseph E Shigly (2008), "Theory of Machines and Mechanisms", Oxford University Press.

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. Khalid Hussain Syed Prof. K. Sridharan Prof. Lenin Babu

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Course Code: MEE2005	HEAT TRANSFER	L	T	P	J	C
Pre-requisite : MEE1003		2	1	0	4	4

Module	Topics	L Hrs	SLO
1	**Fundamental Concepts:** Basic principles of heat conduction, convection and thermal radiation; Fundamental laws; Identification of significant modes of heat transfer in practical applications.	2	1, 2
2	**Conduction I:** General equation of heat conduction in Cartesian, cylindrical and spherical coordinates; One dimensional steady state conduction in simple geometries - plane wall, cylindrical and spherical shells; Electrical analogy; Conduction in composite walls and shells; Critical thickness of insulation; Thermal contact resistance; Overall heat transfer coefficient; One dimensional steady conduction heat transfer with internal heat generation in plane walls, cylinders and spheres.	8	1,2, 9
3	**Conduction II:** Steady state heat conduction in 2D systems - graphical and numerical methods of solution; Conduction shape factor; Unsteady state heat transfer – Systems with negligible internal resistance - lumped heat capacity analysis, infinite bodies – flat plate, cylinder and sphere – chart solutions.	4	1,2, 7, 9
4	**Convection I:** Review of fluid mechanics concepts; Equations of conservation of mass, momentum and energy. Forced convection: External flow over flat plate, cylinder, sphere and tube bundles; Internal flow through circular pipes; Boundary layer flow for flow over a flat plate, curved objects and flow through circular pipes.	5	1, 2, 9
5	**Convection II:** Natural convection: Steady one dimensional flow over vertical, horizontal and inclined plates; Steady one dimensional flow over cylinders and spheres. Combined free and forced convection. Introductory concepts on Boiling and Condensation.	4	1, 2, 9
6	**Radiation:** Terminology and laws; Black body; Radiation from real surfaces; Effect of orientation - view factor; Electrical analogy - surface and space resistances.	3	1, 2, 9
7	**Practical applications:** Extended surfaces (fins); Heat exchangers; Radiation shields.	2	1, 2
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Industrial Visit, challenging assignments, minimum of 2 guest lectures by industry experts.			
Tutorial # A minimum of 5 problems to be worked out by students in every Tutorial Class. ## Another 5 problems per Tutorial Class to be given as home work. ### At least one open ended design problem to be given. Tutorial class for Module 1 (1 hour) Tutorial class for Module 2 (3 hours) Tutorial class for Module 3 (2 hours)		**15**	1,2,7,9

Tutorial class for Module 4 (3 hours) Tutorial class for Module 5 (1 hour) Tutorial class for Module 6 (3 hours) Tutorial class for Module 7 (2 hours)		
Project # Generally a team project [5 to 10 members] # Concepts studied in Thermodynamics and Heat Transfer to be applied. # Focus on innovative design for real life application # Report in digital format with all drawings and analyses performed using software. # Assessment on a continuous basis with a minimum of 3 reviews. **Sample project:** 1. Numerical solution of heat transfer in a 3D Cartesian geometry using FD/FV methods - comparison of manual calculations and simulation results. 2. Analytical solution of 2D transient heat conduction in a rectangular solid. 3. Fabrication of an apparatus for measuring thermal conductivity of a given solid/liquid sample. 4. Parametric studies of natural and forced convection over different geometries - comparison of experimental and theoretical values. 5. Development of a software for computing radiation view factors of a given composite system. 6. Design and fabrication of a radiation shield. 7. Evaluation of thermal storage capacities of various phase change materials. 8. Design, fabrication and testing of heat exchangers. 9. Fin design for laptop cooling/automobile engines. 10. Parametric analyses of different fin shapes and materials. **11.** Theoretical and experimental determination of critical radiation thickness.	**60** [Non-contact hrs]	5, 6, 7, 14, 17, 18, 19, 20

Text Book

1. Yunus A. Cengel (2006), Heat and Mass Transfer-A Practical Approach, McGraw Hill Education.

Reference Books

1. T. L. Bergman, A. S. Lavine, F. P. Incropera and D. P. DeWitt (2011), Fundamentals of Heat and Mass Transfer, 7th Edition, John Wiley & Sons.
2. J. P. Holman (2011), Heat Transfer, 10th Edition, McGraw-Hill Publishing Company Limited.
3. C. P. Kothandaraman and S. Subramanyan (2004), Heat and Mass Transfer Data Book, Fifth Edition, New Age International Publishers.
4. R. C. Sachdeva (2009), Fundamentals of Engineering Heat and Mass Transfer, New Age International (P) Ltd.

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. Y. Raja Sekhar Prof. Saleel Ismail

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Course Code : MEE2006	MACHINING PROCESSES AND METROLOGY	L	T	P	J	C
Pre-requisite : MEE1007		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**Metal Cutting -** Mechanics of metal cutting - cutting tool materials, temperature, wear, and tool life considerations, geometry and chip formation, surface finish and machinability, optimization.	4	1, 2, 6, 17
2	**Basic Machine Tools -** Lathe and its types - Constructional details including accessories and attachments, operations, types of lathe, Contructional and operational details of Shaping - Planing - Slotting – Drilling - Boring – Reaming – Tapping – Broaching.	4	1,2,6,17
3	**Milling machine -** Cutters - Milling operations - Indexing – **Gear Generation:** Gear generating principles - Gear Hobber - Gear finishing methods - Bevel gear generator.	4	1,2,6, 17
4	**Grinding machine**- Operations and applications of surface, cylindrical and centreless grinding processes, dressing, truing and balancing of grinding wheels, grading and selection of grinding wheels, micro-finishing (honing, lapping, super-finishing).	4	1,2,6,17
5	**Unconventional methods** - Electro-chemical, electro-discharge, ultrasonic, LASER, electron beam, water jet machining.	4	1,2,6,17
6	**Introduction to Metrology -** Linear and angular measurements – taper measurement, threads, surface finish, inspection of straightness, flatness and alignment-– Comparators - Gear testing.	4	1, 2,6,17
7	**Advances in Metrology -** Precision Instrumentation based on Laser Principals, Coordinate measuring machines, Optical Measuring Techniques: Tool Maker's Microscope, Profile Projector. Nano-measurements: Scanning Electron Microscope-.Atomic Force Microscopy-Transmission Electron Microscopy.	4	1, 2,6,17
8	**Contemporary Discussion**	2	2
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Industrial Visit, challenging assignments, minimum of 2 guest lectures by industry experts.	**Total Lecture Hours**	**30**	
Projects # Generally a team project of Five # # Concepts studied in different Modules, as relevant, should have been used ### Report in Digital format with to be submitted **Sample Projects:** 1. Fabricate a combination drill jig/milling fixture used for both types of operations on the same part. 2. Manufacture a heel clamp with the help of a lever pressure acting as a strap on the workpiece. 3. Fabricate abridge clamp with the help of a lever pressure acting as a strap on the workpiece. 4. Fabrication of pneumatic vice. 5. Fabrication of a Double Flank Gear Testing. 6. Fabrication of Whitworth quick return mechanism.	**60** [Non-contact hours]	1,2,5,14, 17

7. Fabricate a Gear Test Rig. 8. Fabricate a cotter joint. 9. Fabricate a universal coupling.		

Text Book

1. Serope Kalpakjian; Steven R. Schmid (2013), Manufacturing Engineering and Technology, 6th Edition, Publisher: Prentice Hall, ISBN-10 0-13-608168-1, ISBN- 13 978-0-13-608168-5.

Reference Books

1. P.N.Rao (2013), Manufacturing Technology, McGraw Hill Education, New Delhi.
2. R.K. Rajput (2015), A Textbook of Manufacturing Technology, Laxmi publications, New Delhi.
3. P.C. Sharma (2000), Text book of Production Technology, S.Chand & Company Ltd, New Delhi.
4. O.P. Khanna & M. Lal (2006), A Text book of Production Technology, Dhanpat Rai Publications, New Delhi.

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. C. Pandivelan Prof. M. Senthil Kumar

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Course Code: MEE3001	DESIGN OF MACHINE ELEMENTS	L	T	P	J	C
Pre-requisite : MEE2002		2	1	0	0	3

Module	Topics	L Hrs	SLO
1	**Introduction to Design Process:** Introduction to Design process – Factors – Materials selection - direct - Bending and Torsional stress equation - Impact and Shock loading - Factor of safety - Design stress - Theories of failures – Problems.	4	1,2,5,14
2	**Fatigue strength:** Stress concentration - theoretical stress concentration factor - Size factor - Surface limits factor - fatigue stress concentration factor - notch sensitivity - Variable and cyclic loads – Fatigue strength – S-N curve – Continued cyclic stress – Soderberg and Goodman equations.	4	1,2,5,9
3	**Design of Mechanical Springs:** Stresses and deflections of helical springs – extension -compression springs – springs for fatigue loading, energy storage capacity – helical torsion springs – Flat Spiral Springs - leaf springs. Computer aided design of springs.	4	1,5,9,11, 18
4	**Design of Riveted, Welded and Bolted Joints:** Riveted, Welded and Bolted Joints, Computer aided design of joints	4	1,2,5,12
5	**Design of Keys, cotters and knuckle joints:** Design of keys-stresses in keys-cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints-knuckle joints.	4	1,5,7,9, 17,18
6	**Design of Shafts and Couplings:** Design of solid and hollow shafts for strength and rigidity – design of shafts for combined bending and axial loads – shaft sizes. Computer aided design of shafts and analysis- Design of couplings – Rigid – Muff, Split muff and Flange couplings - Flexible – Oldham, Universal couplings. Computer aided design of Couplings	6	1,5,9,11, 17,18
7	**Design of Engine Components:** Design of Piston – Connecting rod – Crankshaft – Flywheel.	2	5,9,11,18
8	**Contemporary Discussion**	2	2
	Total Lecture Hours		
	# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Industrial Visit, challenging assignments, minimum of 2 guest lectures by industry experts.	**30**	
	Tutorial Tutorial class for Module 1 (3 hours) Tutorial class for Module 2 (2 hours) Tutorial class for Module 3 (2 hours) Tutorial class for Module 4 (2 hours) Tutorial class for Module 5 (2 hours) Tutorial class for Module 6 (2 hours) Tutorial class for Module 7 (1 hour) Tutorial class for Module 8 (1 hour) # A minimum of 2 problems to be worked out by students in every tutorial class. Another 4 problems per Tutorial Class to be given as home work. # **Mode**: Individual Exercises, Team Exercises, Online Quizzes, Online Discussion Forums, challenging Assignments	**15**	1,2,7,9, 12,17,18, 19

Text Book

1. Joseph Edward Shigley and Charles, R. Mischke (2008), Mechanical Engineering Design, McGraw – Hill International Editions, 8th edition.

Reference Books

1. V.B. Bhandari (2010), Design of Machine elements, Tata Mc Graw Hill, 3rd Edition.
2. P.C.Sharma & D.K.Aggarwal (2012), A Text Book of Machine Design, S.K.Kataria & Sons, New Delhi,12th edition,.
3. Jack A.Collins, Henry Busby, George Staab (2011), Mechanical Design of Machine Elements and Machines, 2nd Edition, Wiley India Pvt. Limited.
4. B.J. Hamrock, and S.R. Schmid (2005), Fundamentals of Machine Elements, Tata McGraw Hill, New Delhi.
5. Juvinal, R.C and Kurt M.Marshek (2012), Machine component design, John Wiley.
6. Design Data (2010) – PSG College of Technology, DPV Printers, Coimbatore.
7. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger (2003), Design of Machine Elements, 8th Edition, Printice Hall.

Mode of Evaluation	Digital Assignments /Seminars/ Surprise Test /CAT/FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. E. Rajkumar Prof. Bhaskara Rao

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Course Code: MEE4099	CAPSTONE PROJECT (1 SEMESTER)					
Pre-requisite : Completion of 7 semesters		L	T	P	J	C
						20

	Topics		SLO
	The Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, etc. or a combination of these.		1,2,5, 6,7,9, 10, 11, 12,13, 14,16, 17,18

Assessment / Criteria

1. Can be individual work or a group project, with a maximum of 3 students.
2. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
3. Carried out inside or outside the university, in any relevant industry or research institution.
4. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation	Mid reviews, Final Viva-Voce, Thesis and Poster Submission
Recommended by the Board of Studies on:	**03.03.2016**
Date of Approval by the Academic Council:	
Compiled by	Prof. K. Devendranath Ramkumar Prof. R. Sivakumar Prof. M. Anthony Xavior

Course Code: MEE3099	INDUSTRY INTERNSHIP					
Pre-requisite : After 2 years		L	T	P	J	C
		--	--	--	--	2

	Topics		SLO
	• Exposure to managerial skills and understanding of the process execution in industries • Four weeks of work at industry site • Supervised by an expert at the industry		2,5,10, 11,12, 13,16, 18

Method:

1. Students have to maintain a written record of the assignments, progress and accomplishments. They have to submit a report at the end of this training.
2. An oral presentation on their experiences and the knowledge gained during their work.

Mode of Evaluation	Oral Viva-Voce, Report
Recommended by the Board of Studies on:	**03.03.2016**
Date of Approval by the Academic Council:	**18.03.2016**
Compiled by	Prof. K. Devendranath Ramkumar Prof. R. Sivakumar Prof. M. Anthony Xavior

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Course Code: MEE4098	COMPREHENSIVE EXAMINATION					
Pre-requisite : End of 7th Semester		L	T	P	J	C
		--	--	--	--	2
	Topics					

Weightage of Courses

Course Code	Course Name	% Weightage
MEE1002	Engineering Mechanics	8
MEE1005	Materials Engineering and Technology	8
MEE1003	Engineering Thermodynamics	8
MEE1007	Manufacturing Processes	6
MEE1004	Fluid Mechanics	6
MEE2001	Machine Drawing	3
MEE2002	Strength of Materials	8
MEE2004	Mechanics of Machines	8
MEE2003	Thermal Engineering Systems	6
MEE2006	Machining Processes and Metrology	6
MEE3001	Design of Machine Elements	6
MEE2005	Heat Transfer	6
MEE2026	Turbomachines	6
MEE4007	Design of Transmission Systems	5
MEE2007	CAD/CAM	4
MEE1014	Industrial Engineering and Management	3
MEE1024	Operations Research	3

Mode of Evaluation	Online Test
Recommended by the Board of Studies on:	**03.03.2016**
Date of Approval by the Academic Council:	
Compiled by	Prof. K. Devendranath Ramkumar Prof. R. Sivakumar Prof. M. Anthony Xavior

PROGRAMME ELECTIVES

VIT UNIVERSITY
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Course Code : CHE2006	FUELS AND COMBUSTION	L	T	P	J	C
Pre-requisite : MEE1003		3	0	0	0	3

Module	Topics	L Hrs	SLO
1	**Fuel basics** – Types and Characteristics of Fuels – Determination of Properties of Fuels – Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination.	5	1,2,4,5, 11
2	**Fuel characterization** - Calorific Value - Gross and Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation - Flue gas Analysis - Orsat Apparatus - Fuel and Ash Storage and Handling.	6	1,2,4,5, 11
3	**Solid Fuel** - Wood and Wood charcoal - Origin of coal-Composition of coal – Analysis and properties of different grades of coal - preparation and storage of coal - coal washing – Briquetting.	6	1,2,4,5, 11
4	**Liquid Fuel** - Origin of petroleum fuels - Production – Composition - Petroleum refining - Various grades of petro-Products - Properties and testing – Alcohol shale oil - Gasification of liquid fuels – Synthetic fuels - Storage and handling of liquid fuels.	6	1,2,4,5, 11
5	**Gaseous Fuel** - Classification - Composition and Properties – Estimation of Calorific Value – Gas Calorimeter. Rich and Lean Gas - Wobbe Index - Natural Gas - Dry and Wet Natural Gas - Stripped NG - Foul and Sweet NG - LPG - LNG - CNG - Methane - Producer Gas - Gasifiers - Water Gas – Town Gas - Coal Gasification – Gasification Efficiency - Non - Thermal Route - Biogas - Digesters - Reactions – Viability – Economics.	8	1,2,4,5, 11
6	**Combustion: Basics and Stoichiometry** - Stoichiometry - Mass Basis and Volume Basis – Excess Air Calculation - Fuel and Flue Gas Compositions – Calculations - Rapid Methods - Combustion Processes – Stationary Flame – Surface or Flameless Combustion – Submerged Combustion - Pulsating and Slow Combustion Explosive Combustion.	6	1,2,4,5, 11
7	**Combustion Kinetics** - Mechanism of Combustion – Ignition and Ignition Energy - Spontaneous Combustion - Flame Propagation - Solid - Liquid and Gaseous Fuels Combustion - Flame Temperature - Theoretical - Adiabatic and Actual - Ignition Limits – Limits of Inflammability.	6	1,2,4,5, 11
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**45**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts.

Text Book

1. Samir sarkar (2000), Fuels and Combustion, Orient Longman.

Reference Books

1. Roger A (2000), Combustion Fundamentals, MeGraw Hills, New Delhi.
2. Shaha AK (2003), Combustion Engineering & Fuel Technology, Oxford and IBH Publications, New York.
3. Kenneth K Kou (2002), Principles of Combustion, Wiley & Sons Publications, New York.

Mode of Evaluation	Digital Assignments / Surprise Tests / CATs /FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. S. Velu Prof. Feros Khan

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Course Code: EEE2007	Electronics and Microcontroller					
Pre-requisite : NIL		L	T	P	J	C
		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**Number System and Codes:** Introduction to Digital Systems-Number representation-Binary, Octal, Decimal, Hexadecimal- Number Base conversion-Complements:1's and 2's-Signed binary numbers - ASCII,BCD,Excess3andGrayCodes -Parity	3	1,2,9
2	**Digital Electronics:** Introduction to basic gates-arithmetic operations-Boolean algebra- basic theorems and properties of Boolean algebra, Boolean functions, Canonical and Standard Forms. Logic families: TTL, CMOS.	4	1,2,9
3	**Combinational circuits:** Combinational circuits – Analysis and design procedures - Circuits for arithmetic operations - Code conversion. Decoders and encoders - Multiplexers and demultiplexers.	4	1,2,9
4	**Sequential circuits:** Flip Flops-shift registers-Counters- Serial adder, Serial Multiplier.	3	1,2,9
5	**Introduction to Microcontroller:** Introduction to microprocessor and microcontroller- Internal architecture of PIC18-Comparison of PIC with other CISC & RISC based systems and microprocessor-PIC family-features.	4	2
6	**Assembly language programming:** Flag Register, stack- addressing modes, loop, jump, call instructions, arithmetic and logic instructions, Programming I/O ports- timers, counters, interrupts, serial communication	6	1,2,5,6,7
7	**Interfacing with PIC** Interfacing with real world devices: LCD, Keyboard, ADC, DAC, Sensors.	4	1,2,5,6
8	**Contemporary Issues:**	2	2
	Total Lecture Hours	30	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts

List of Projects : **1,2,9,10,11,12,15,17,18**

- Digital countdown timer
- Digital Voltmeter
- Water level Indicator alarm
- Remote room temperature monitoring
- Smart Phone home appliance control
- Sun Tracking Systems
- Electronic Voting Machine
- Street light intensity control
- Gas Leakage Detection System
- Line following Robot

Text Book

1. Donald G. Givone "Digital principles and Design" Tata McGraw Hill 2003.
2. Mohamed Ali Mazidi, Rolin D.McKinlay, Danny Causey,"Pic Microcontroller And Embedded Systems: Using Assembly And C For Pic 18",Pearson Education,2009.

Reference Books

1. M. Morris Mano, "Digital Design", 4th Edition, *Prentice Hall of India Pvt.Ltd.*, 2012..

2. Charles H. Roth, Jr., "Fundamentals of Logic Design", 6th Edition, Brooks/Cole, 2009
3. Thomas L. Floyd & R P Jain, “Digital Fundamentals”, PHI, 10th Edition, 2009
4. Barry B. Brey, “Applying PIC18 Microcontrollers”, Pearson/Prentice Hall, 2008
5. Sid Katzen, “The Essential PIC18® Microcontroller”, Springer, 2010

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Course Code : MEE1008	MEMS					
Pre-requisite : Nil		L	T	P	J	C
		3	0	0	0	3

Module	Topics	L Hrs	SLO
1	**Introduction to MEMS -** Unique characteristics of MEMS, Microsystems Technology- An Overview, typical MEMS and Microsystem Products.	4	2
2	**Laws and applications of MEMS -** Scaling effects - scaling laws in miniaturization- Application of MEMS and Microsystems- Future Directions of MEMS.	4	1, 2,14
3	**Material for MEMS and manufacturing -** Structure of silicon and other materials - Silicon wafer processing - Bulk micromachining and Surface micromachining, Wafer-bonding. Thin-film deposition, Lithography, wet etching and dry etching.	6	1, 2, 14
4	**Other Micro-fabrication methods -** LIGA and other moulding techniques- Soft lithography and polymer processing- Thick-film processing; Low temperature co-fired ceramic processing-.Smart material processing.	5	5, 2,14
5	**MEMS components-micro sensors and Micro-actuators:** Micro sensors - Basic principles and working of micro sensors- Acoustic wave micro sensors- Bio-medical micro sensors- Bio-sensors- Chemical micro sensors – Optical Sensors – Pressure micro sensors- Thermal micro sensors- acceleration micro sensors; Micro actuators - Basic principles and working of micro actuators- Electrostatic micro actuators- Piezoelectric micro actuators- Thermal micro actuators- SMA micro actuators- Electromagnetic micro actuators, micro valves, micro pumps.	11	2, 14
6	**Micro fluidics -** Fundamentals of fluid mechanics- Basic components of a micro fluidic system- Micro flows- Micro pumps- Capillarity and Surface Tension- Micro pumping methods- Micro dispensers- Micro nozzles.	5	2,14
7	**Case studies -** MEMS as Gas sensors – MEMS Accelerometer - Development of Proximity Sensor - MEMS based Current sensors - MEMS for Smart homes - MEMS for Visually impaired -MEMS Sensors for object detection - MEMS based touch sensor - Synthesis and characterization of Micro fluids - Development of thin film MEMS layers.	8	2,14
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**45**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts.

Text Book

1. Tai-Ran-Hsui (2013), MEMS & Microsystems: Design and Manufacture, McGraw Hill, 17th Reprint.

Reference Books

1. Nadim Maluf and Kirt Williams (2004), An Introduction to Microelectro mechanical Systems Engineering, Second Edition, Artech House Print on Demand, ISBN-13 978-1580535908.
2. Stephen R.Santuria (2001), Microsystem Design, Springer Science-Business Media Inc.
3. Minhang Bao (2005), Analysis and Design Principles of MEMS devices,Elsevier.
4. Marc J. Madou (2002), Fundamentals of Micro Fabrication: The Science of Miniaturization, Second Edition, CRC.
5. Nitaigour Premchand Mahalick (2007), MEMS, Tata McGraw Hill.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT

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Compiled by	Prof. DRS Raghuraman Prof. Pratibha Nalini

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Course Code: MEE1009	NEW PRODUCT DEVELOPMENT	L	T	P	J	C
Pre-requisite : NIL		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**New Product Development:** Introduction to New Product Development, Need for developing new products — Evolution of design, types of design – the design process –product life cycle – generic product development process – Strategic Planning and Opportunity Identification for new products – Identifying Market Opportunities.	4	1, 2, 5,6, 15,17
2	**Translation of needs into Specifications:** Understanding Customer and User Needs – customer survey – need gathering methods – clarification - search-externally and internally - Explore systematically - needs importance - establishing product specification -competitive benchmarking. Case Studies-I.	4	1, 2,5, 6, 10, 15, 17
3	**Creativity and Innovation:** Need for design creativity - Creative thinking – creativity and problem solving - creative thinking methods- generating design concepts - systematic methods for designing –morphological methods - TRIZ methodology of Inventive Problem Solving. Case Studies-II.	4	1, 2, 5,6, 17,18
4	**Concept Development:** Concept Generations- Concept Screening- Concept Scoring - Concept Testing methods. Case Studies-III.	3	1, 2,5, 6, 10,17
5	**Embodiment Design:** Introduction to embodiment design – product architecture – types of modular architecture –steps in developing product architecture Industrial design – human factors design –user friendly design – Case Studies-IV.	4	1, 2,5, 6,10, 17
6	**Design for X:** Design for serviceability – design for environment – prototyping and testing – Cost evaluation –categories of cost – overhead costs – activity based costing. Case Studies-V. Design for Quality - Reliability - Failure Mode and Effect Analysis - Test and Inspection – Maintenance - Warranty.	6	1, 2,5, 6,10, 17
7	**Patents and Intellectual Property**: Patent – trademark - trade secret – copyright - preparing a disclosure.	3	1, 2,6 10, 17
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	30	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts

Project

- Generally a team project [Maximum of 3 members only]
- Concepts studied should have been used.
- Down to earth application and innovative idea should have been attempted

Assessment on a continuous basis with a minimum of 3 reviews.

Sample projects:

- New product development starting from customer survey, product specification, concept generation, concept selection, concept testing and prototyping.
- Redesign of an existing product from customer survey, product specification, concept generation, concept selection, concept testing and prototyping.

60 [Non-contact hours] | 5,6,9, 17,18

• Design modification of an existing product from customer survey, product specification, concept generation, concept selection, concept testing and prototyping.		

Text Book

1. Karl T. Ulrich, Steven D. Eppinger (2015), Product Design and Development, Sixth Edition, McGraw-Hill.

Reference Books

1. Kevin Otto, Kristin Wood (2004), Product Design, Pearson Education, ISBN 9788177588217.
2. Chandler Allen Phillips (2000), Human Factors Engineering , John Wiley and sons, New York.
3. Stephen C. Armstrong (2001), Engineering and product development management – the holistic approach, Cambridge university press.
4. Semyon D. Savransky (2000), Engineering of Creativity – TRIZ , CRC Press, New York, USA.
5. Clayton M. Christensen, Michael E. Raynor (2003), The Innovator‟s Solution , Harvard Business School Press, Boston, USA.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Course Code : MEE1011	RENEWABLE ENERGY SOURCES	L	T	P	J	C
Pre-requisite : Nil		2	0	2	4	4

Module	Topics	L Hrs	SLO
1	**Classification of Energy –** Energy chain and common forms of usable energy - Present energy scenario - World energy status - Energy scenario in India - Introduction to renewable energy resources - Introduction to Solar Energy - Energy from Sun - Spectral distribution of Solar radiation - Instruments for measurement of solar radiation - Solar radiation data analysis.	5	1,2
2	**Applications of Solar Energy –** Thermal applications - Introduction to Solar thermal collectors - Types - Principle of operation of different collectors - Flat plate - Evacuated tube collectors - Compound parabolic collectors - Solar air heaters - Solar dryers -solar cookers - solar stills - Solar ponds - concentrating collectors - line type - point type - Methods of Solar power generation - Power towers.	6	1,2,5
3	**Introduction to Solar Photovoltaics –** Physics of solar cells - Cell and module. **Manufacturing Process –** Characteristics of cells and module - Performance parameters - BoS - PV System applications - Stand alone- Grid connected systems.	5	1,2,5
4	**Bio Energy Sources –** Energy through various processes - Energy through fermentation - Gasification - various types of gasifiers - Pyrolysis - Fixed bed and fast Pyrolysis - Bio energy through digestion - Types of Digesters- Factors affecting the yield of products.	4	1,2,5
5	**Wind Energy –** resource assessment - types of wind turbines - selection of components - blade materials - power regulation - various methods of control - wind farms - site selection - off shore wind farms - Solar Wind Hybrid energy systems.	4	1,2,5
6	**Small Hydro Power Systems** – Introduction - types - system components, discharge curve and estimation of power potential - Turbines for SHP.	2	1,2,5
7	**Ocean Energy** – Power generation through OTEC systems - various types - Energy through waves and tides - Energy generation through geothermal systems – types.	2	1,2,5
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts.			
Laboratory 1. Estimation of Solar radiation : Pyranometer, pyrheliometer. 2. Testing the yield of a Solar still in outdoor conditions (Multiple sessions). 3. Wind Energy Experimental Set up – I. 4. Wind Energy Experimental Set up – II. 5. Testing of Solar PV system in PV training Kit. 6. Fuel Cell Experiment. 7. Performance of Biomass stove.		**30**	5,7,9

8. Production of Bio-diesel by Transesterification process. 9. Flash Point and Fire point comparison for conventional fuels and alternate fuels. 10. Production of Hydrogen from Electrolysis with PV system. 11. Estimation of Figures of Merit in a Solar cooker. 12. Performance characteristics of a Solar thermal collector. 13. Exergy analysis of a Solar cabinet dryer.		
Project # Generally a team project of Five. # Concepts studied in Modules should have been used. # Down to earth application and innovative idea should have been attempted. **Sample Projects:** 1. Development of software tools for estimation/ calculation of solar energy (apps/ Front end tool etc). 2. Development of a Solar cooker with energy storage using scrap materials. 3. Design and develop a Solar Lantern with suitable energy storage. 4. Development of a solar thermo electric cooling system. 5. Design of a smart grid involving various RE technologies. 6. Resource assessment (Wind/Solar/Biomass energy). 7. Estimation of Solar radiation through ANN involving various atmospheric factors. 8. Tracking mechanism for any solar thermal concentrating device – cooker, Dish, PTC, etc. 9. Energy and Exergy analysis of any renewable energy device – Based on Solar, Wind, Bio-mass, etc. 10. Analysis of any renewable energy device using TRNSYS. 11. Making and characterizing a DSSC solar cell. (Sun Simulator and IV measurement apparatus id required). 12. Design and analysis of any Hybrid power generation system. **13.** Performance comparison of different renewable energy devices.	**60** [Non-Contact hrs]	5,6,7,11

Text Book

1. John Andrews, Nick Jelley (2013), Energy Science: Principles, technologies and impacts, Oxford Universities press.

Reference Books

1. Fang Lin You, Hong ye (2012), Renewable Energy Systems, Advanced conversion technologies and applications, CRC Press.
2. John.A.Duffie, William A.Beckman (2013), Solar Engineering of Thermal processes, Wiley.
3. A.R.Jha (2010), Wind Turbine technology, CRC Press.
4. Godfrey Boyle (2012), Renewable Energy, power for a sustainable future, Oxford University Press.

Mode of Evaluation	Digital Assignments / Surprise Tests / Seminars / CATs /FAT
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Course Code : MEE1012	ALTERNATIVE FUELS	L	T	P	J	C
Pre-requisite : Nil		3	0	0	0	3

Module	Topics	L Hrs	SLO
1	**Introduction:** Status of petroleum reserves, economics; Need for alternative fuels; Review of fuel properties.	2	1,10,11
2	**Hydrogen:** Properties; Production and storage methods; Safety aspects; Use in SI and CI engines; Performance and emissions.	6	1,2
3	**Organic gaseous fuels:** Natural Gas, LPG, biogas, producer gas, syngas etc.; Properties; Production and storage methods - CNG and LNG, gasification, digesters; Use in SI and CI engines; Performance and emission characteristics; Dual fuel and HCCI modes.	10	1,2
4	**Alcohols and ethers:** Methanol and ethanol; DME and DEE; Properties; Production methods; Use in SI and CI engines - blends and emulsions; Performance and emissions.	10	1,2
5	**Vegetable oils:** Types, composition and properties; Challenges of use in CI engines, solutions - preheating, blending; Transesterification; Performance and emissions; Oils from waste - cooking oil, wood, rubber, plastic etc.	10	1,2
6	**Solid fuels:** Biomass - processing and usage, forms - municipal solid waste, wood.	2	1,2
7	**Clean technology:** Fuel cells - types, working; Hybrid and electric vehicles; Solar power; Challenges; Engine performance.	3	1,2,10
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**45**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts.

Text Book

1. Thipse S. S. (2010), Alternative Fuels: Concepts, Technologies and Developments, Jaico Publishing House.

Reference Books

1. Ganesan V. (2012), Internal Combustion Engines, McGraw-Hill Education India Pvt. Ltd.
2. Michael F. Hordeski (2013), Alternative Fuels: The Future of Hydrogen, The Fairmont Press, Inc.
3. Larminie J., Lowry J. (2004), Electric Vehicle Technology Explained, Wiley.
4. Daniel J. Holt (2003), Fuel Cell Powered Vehicles: Automotive Technology of the Future, Society of Automotive Engineers (SAE).
5. Richard L.Bechtold (2014), Alternative Fuels Guidebook, Society of Automotive Engineers (SAE).

Mode of Evaluation	Digital Assignments / Surprise Tests / Seminars / CATs /FAT
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Compiled by	Prof. Thangaraj Prof. Saleel Ismail

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Course Code: MEE1014	INDUSTRIAL ENGINEERING AND MANGEMENT	L	T	P	J	C
Pre-requisite : Nil		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**Introduction to macro and micro economics**: Macro economic measures – micro economics – Demand and supply – Determinants of demand and supply – Elasticity of demand – Demand forecasting techniques (short term & long term) – Problems.	4	1, 2
2	**Elements of cost:** Determination of Material cost - Labour cost – Expenses - Types of cost – Cost of production – Over-head expenses–break even analysis - Problems.	3	1,2
3	**Productivity:** Definition – Factors affecting- Increasing productivity of resources - Kinds of productivity measures - Case study.	2	1,2
4	**Introduction to work study:** Method study – Time study – stopwatch time study – Work measurement - performance rating- allowances – Ergonomics.	4	1,2
5	**Plant location and Plant layout:** Plant location –need - Factors – comparison – quantitative methods for evaluation Plant layout: objectives-principles – factors influencing – tools and techniques including computer based layout design – CRAFT, ALDEP, CORELAP.	6	1,2,5
6	**Cellular Manufacturing:** Group Technology – Cellular layout – Machine-Part Cell Formation (MPCF) – Heuristic approaches – Hierarchical clustering for MPCF.	4	1,2,5
7	**Material requirement Planning (MRP):** Objectives – functions – MRP system – MRP logic – Management information from MRP – lot sizing consideration – Manufacturing resource planning – capacity requirement planning (CRP) –Bill of material.	4	1,2,5
8	**Contemporary Discussion**	3	2
	Total Lecture Hours	**30**	
	# Mode: Flipped Class Room, [Lecture to be videotaped], Visit to Industry, Min of 2 lectures by industry experts		
Project • Generally a team project [Maximum of 3 members only]. • Concepts studied should have been used. • Down to earth application and innovative idea should have been attempted. • Assessment on a continuous basis with a minimum of 3 reviews. 1. **Sample projects:** Demand Forecasting (Cars, food items, cell phones etc.,) 2. Method study for reducing the cycle time 3. TQM related projects including the '5S' approach 4. MPCF using heuristics / soft computing tools 5. Layout redesign Assessment on a continuous basis with a min of 3 reviews.		**60** [Non Contact Hours]	6,7,9, 14,17

Text Book

1. R Dan Reid , and Nada R. Sanders (2012), Operations Management, John wiley& Sons, 5th Edition.

Reference Books

1. Martand Telsang (2006), Industrial Engineering and Production Management, S. Chand.
2. R Panneerselavam (2012), Production and Operations Management, PHI publications3rd Edition.

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Course Code: MEE1015	TOTAL QUALITY MANAGEMENT AND RELIABILITY	L	T	P	J	C
Pre-requisite : Nil		3	0	0	0	3

Module	Topics	L Hrs	SLO
1	**Introduction:** Definition of Quality, Differing perspectives of quality by Design, Manufacturing, Service, etc. Deming's 14 principles, Quality Planning, Customer orientation and Customer satisfaction measurement, Quality Control, Quality assurance and Total Quality Management definitions, Human influence on quality, Employee loyalty.	6	1, 2
2	**Quality Planning**: Definition, P Diagram, Characteristics matrix, Process flow, Process FMEA, Special characteristics, Tolerance design, Process capability, Cp, Cpk, Statistical Process control, Measurement system analysis.	6	1,2
3	**TQM Techniques**: Introduction to TQM, Principles of TQM, QFD, Bench Marking, 5S, Employee empowerment.	6	2,5,6
4	**Continuous Improvement Techniques:** Quality Objectives**,** Bench Marking, Poka Yoke and Corrective and Preventive actions with examples.	6	
5	**Problem Solving tools:** 7 QC tools, New Management tools, Six Sigma approach, TRIZ, Taguchi Loss function. case studies and problems.	6	1,2
6	**Reliability**: Introduction to reliability, Failure rate, System reliability - Series, Parallel and mixed configuration, Problems, Weibull distribution and application.	6	2,5,6
7	**Maintenance Maintainability:** Mean time to repair, Mean time between failures, Predictive maintenance**,** Reliability Centered Maintenance, Reliability improvement – Redundancy – Element – Unit and stand by redundancy – Reliability allocation for a series system – Maintainability and availability – System downtime – Reliability and Maintainability trade off – Simple problems.	7	1
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**45**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.

Text Book

1. Dale S Besterfiled and Carol Besterfield (2002),Total Quality Management,Printice Hall, ISBN : 13: 978-0130993069.

Reference Books

1. Vincent K. Omachonu and Joel E. Rose (2005), Total Quality Management, CRC Press.
2. L.S. Srinath (2005), Reliability Engineering, Affiliated East West Press, New Delhi.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Course Code: MEE1016	LEAN ENTERPRISES AND NEW MANUFACTURING TECHNOLOGY	L	T	P	J	C
Pre-requisite : Nil		3	0	0	0	3

Module	Topics	L Hrs	SLO
1	**Introduction to Lean manufacturing:** Definition and concept of lean manufacturing; Principles of lean manufacturing – Just in time – Types of pull systems - Toyota Production systems – Benefits of lean manufacturing – Theory of constraints – Reduction of wastes.	6	10,11, 15
2	**Lean Manufacturing Tools-1:** Basic tools of lean manufacturing: 5S, Total Productive Maintenance, Key Performance Indicator, Overall Equipment Effectiveness, Plan Do Check Act, Root Cause Analysis, Poka Yoke, Work Cell, Bottleneck analysis, continuous flow.	6	10,11, 15
3	**Lean Manufacturing tools –II:** Secondary tools of lean manufacturing: Gemba, Heijunka , Hoshin Kanri, Jidoka, Load leveling, Mind maps, 5 whys, SMDE, Six Big Losses, Standardized work, Visual factory, Zero quality control.	6	10,11, 15
4	**Strategic Issues and Lean implementation:** Strategic issues: - Actions - Issues - Focus - Leadership - Management of teams – Training. Focused factory concept –. Availability, Variability, Lean implementation strategies, causes for failures, sustaining lean, constraint management.	6	10,11, 15
5	**Process Mapping and Value stream mapping:** Process mapping – Need for process map- Types- Detailed instructions - common mistakes in mapping - limits – facilitation; Value stream mapping: - Overview - Where to use – When to use- Step by step approach – How to use – Present and future states - VSM symbols.	6	10,11, 15
6	**Lean accounting:** Lean accounting definition, Need for lean accounting, benefits of lean accounting, Lean accounting Vs traditional cost accounting, Activity based costing - Product costing - Volume adjusted costing,Target costing	6	10,11, 15
7	**Cellular manufacturing and Group technology:** Work cell – Cell design - Facility planning – Plant layout – Balancing the work in work cells – Takt time – Defining - Benefits - Uses – Limitations; Facilities planning tools; Group technology coding classification; Productivity Improvement Aids.	7	10,11, 15
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**45**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts

Text Book

1. Pascal Dennis (2013), Lean production Simplified, Productivity press, New York.

Reference Books

1. P. James Womack (2003), Lean Thinking: Banish Waste and Create Wealth in Your Corporation, Simon & Schuster.

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Course Code: MEE1017	NEW VENTURE PLANNING AND MANGEMENT	L	T	P	J	C
Pre-requisite : Nil		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**Concepts of Entrepreneurship and Business:** Entrepreneurship; Definition and Types - Entrepreneurship as a career - Competencies and qualities of an entrepreneur - Opportunity Identification and Trend Identification - Factors affecting entrepreneurship; Forms of business organization- Advantages and disadvantages - Steps involved in business establishment - Factors to be considered in plant location.	4	10,11, 15
2	**Feasibility analysis and Sales & Marketing:** Product/service feasibility, Market feasibility, Organizational feasibility, Financial feasibility, Technical feasibility- Market Survey and Market research - Channels of distribution. Pricing methods - full cost, target pricing, marginal cost, go rate, customary, sealed bid etc.	4	10,11, 15
3	**Financial estimatiopn and Sourcing:** Estimation of capital requirements – Pre-operative expenses, Fixed expenses, Working capital; Project financing - Sources of funding- Equity financing - Venture Capital, Angel investors, Debentures and shares- types of shares - Crowd funding.	4	10,11, 15
4	**Financial Accounting:** Financial analysis - Balance sheet - Income statement – Cash flow statement – Break even analysis; Pricing policy and Profit planning; Classification of costs; Break-even analysis - Book keeping and accounting terminology.	4	10,11, 15
5	**Legal aspects Related to business:** Procedure and formalities - Legal aspects relating to Registration, labour, Licenses and clearances. Leasing and Franchising; Intellectual property rights – Patents, Trademarks, Copyrights, Royalty; Employee welfare measures: –Inside and outside organization - PF - ESI - Medical compensation - Risk coverage; Taxation –Income Tax, Service tax, VAT, TDS, and Excise.	4	10,11, 15
6	**Governmental assistance and support to Entrepreneurs-** Incentives, subsidies and grants available from State Government - Incentives, subsidies and grants available from Central Government - Role of DIC and MSME, Role of TBIs, EDIs and other Agencies- Role and support of private agencies.	4	10,11, 15
7	**Business Plan:** Definition, Need and purpose of a Business plan - Contents of Business plan:- Introduction, Executive summary, Project projections, Project details; Competition analysis, competitive advantage - Characteristics of project- General and Technical- Project cost, Production cost, Financial details - Break-even point; Profitability - Pricing for profitability.	4	10,11, 15
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.			
Project • Generally a team project [Maximum of 3 members only].		**60** [Non-Contact Hours]	10,11, 15

• Concepts studied should have been used. • Down to earth application and innovative idea should have been attempted. • Assessment on a continuous basis with a minimum of 3 reviews. **Sample projects:** 1. Project Cost Estimation. 2. Market survey and Market research. 3. Business plan.		

Text Book

1. Bruce R, Barringer, R Duane Ireland (2013), Entrepreneurship- Successfully launching new ventures.

Reference Books

1. David. F. Summen (2014), Forming Entrepreneurial Institution.
2. Sramana Mitra (2013), Entrepreneur Journeys.
3. Harold. P. Welsch (2003), The Entrepreneurship: The way ahead.
4. Hand Book for New Entrepreneurs (2008), P.C Jain Entrepreneurship Institute of India, Ahmedabad, India.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Course Code: MEE1018	FACILITIES AND PROCESS PLANNING	L	T	P	J	C
Pre-requisite : Nil		3	0	0	0	3

Module	Topics	L Hrs	SLO
1	**Facilities Planning:** Introduction to facilities Planning, Significance of Facilities Planning, Objectives of Facilities Planning, Facilities Planning Process, Strategic Facilities Planning, Developing Facilities Planning Strategies.	6	1,2,3
2	**Product process and schedule design, Flow systems, activity relationships and space requirements:**Introduction, Product Design, Process Design, Schedule Design, Facilities Design, Flow Systems, Material Flow System, Departmental Planning, Activity Relationships, Space Requirements.	6	1,2
3	**Plant Location:** Basic Factors to be considered – Plant location and site selection – Consideration in facilities planning and Layout capacity – Serviceability and flexibility – Analysis in selection of Equipment – Space requirement – Machine selections, Labour Requirement and selection.	6	1, 2, 3, 4, 5, 7, 10, 14, 16, 17, 18
4	**Layout Planning:** Types of Layout – Factors influencing product - Process - Tools and Techniques for developing Layout. Developing and Analysis of plant Layout – Presenting the Layout – Office Layout plot planning. Evaluation and Improvement of Layout.	6	1,2,3,7 10, 12, 14, 16, 17
5	**Computer Aided Plant Layout:** Data requirements – Mathematical programming procedures - Heuristics – CORE LAP - PLANET - MAT - CRAFT- Probabilistic Approach - Random selection (ALDEP) - Based sampling - Simulation – Graph Theory – Facility design – Layout states – Scale effect. Criticism concerning Computer Aided Plant Layout.	6	1,2,15, 16,17
6	**Material Handling:** Objectives – Principles – Types – Degree of mechanization – Unit load concept – Material Handling cost – Relationship between Material Handling and Plant Layout – Material Handling system Design - Specification of the Design – Analyzing an existing material Handling system. Basics of material handling selection – AGVS in material Handling – Packing.	6	1,2,3, 13,16, 17, 18
7	**Evaluation and Implementation of layout:** Evaluating the Layout – Qualitative Evaluation Techniques - Efficiency indices – Cost Evaluation of Layout – Quantitative evaluation Techniques – Evaluation procedures – Making the alteration – Presenting the Layout to management – Displaying the Layout – Follow up – Approval – Reproducing the Layout - Installing the Layout.	6	1,2,11
8	**Contemporary discussion**	3	2
	Total Lecture Hours	45	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.

Text Book

1. James A Tompkins, John A White, Yavuz A Bozer, JMA Tanchoco (2010), Facilities planning, Fourth edition, Wiley.

Reference Books

1. John R. Immer (2004), Layout planning Techniques, McGraw-Hill Book Company.
2. James M. Apple (2000), Plant Layout and Material Handling, The Ronald Press Company.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Course Code: MEE1024	OPERATIONS RESEARCH	L	T	P	J	C
Pre-requisite : MAT 2		2	1	0	0	3

Module	Topics	L Hrs	SLO
1	**Linear Programming Problem**: Introduction to Operations Research – Linear Programming - Mathematical Formulation – Graphical method – Simplex method – Penalty methods: M-method, Two Phase method- Duality.	4	1, 2, 4, 5, 7, 9,17
2	**Transportation problem:** Introduction - Formulation - Solution of the transportation problem (Min and Max): Northwest Corner rule, row minima method, column minima method, Least cost method, Vogel's approximation method – Optimality test: MODI method.	4	1, 2, 5, 9, 17
3	**Assignment and Sequencing Models:** Assignment problems – Applications - Minimization and Maximization; Sequencing - Problem with N jobs and 2 machines – n jobs and 3 machines problem - n jobs and m machines problem.	3	1,2
4	**Project Management**: Introduction - Phases of project management- Construction of Network diagrams- Critical path method (CPM) and Project evaluation and review technique (PERT) - Crashing of project network.	4	1, 2, 4, 5, 9,19
5	**Inventory control:** Necessity for maintaining inventory - Inventory costs - Inventory models with deterministic demand - inventory models with probabilistic demand - Inventory models with price breaks - Buffer stock.	4	1, 2, 4, 7, 9, 17
6	**Queuing models:** Poisson arrivals and Exponential service times – Single channel models and Multi-channel models - Simulation: Basic concepts, Advantages and disadvantages - Random number generation - Monte Carlo Simulation applied to queuing problems.	4	1, 2, 4, 5, 7, 9
7	**Game theory:** Competitive games - Useful terminology - Rules for game theory - Two person zero sum game – Property of dominance - Graphic solution – Algebraic method. **Replacement models:** Replacement of items that deteriorate with time: No changes in the value of money, changes in the value of money - Items that fail completely: Individual replacement and group replacement policies.	5	1, 2, 7, 9, 17
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.

Tutorial	**15**	
Tutorial Class for Module 1 Tutorial Class for Module 2 Tutorial Class for Module 3 Tutorial Class for Module 4 Tutorial Class for Module 5 Tutorial Class for Module 6 Tutorial Class for Module 7 Tutorial Class for Module 8		1, 2, 4, 5, 7, 9, 17
# A minimum of 3 problems to be worked out by students in every tutorial class. Another 5 problems per tutorial class to be given as home work. # Mode: Individual exercises, Team exercises.		

Text Book

1. Hamdy A Taha (2014), Operations Research: An Introduction, 9th edition, Pearson Education, Inc. **Reference Books** 1) Hira D S and Gupta P K (2014), Operations Research, Revised edition, S. Chand & Sons. 2) Panneerselvan. R. (2009), Operation Research, 2nd edition, Prentice Hall of India Pvt Ltd. 3) KantiSwarup, Gupta P.K., and Man Mohan (2015), Operations Research, 18th edition, S. Chand &Sons. 4) JK Sharma (2012), Operations Research: Theory and Applications, 5th edition, Lakshmi Publications, New Delhi 5) Manohar Mahajan (2013), Operations Research, Dhanpat Rai & Co.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Course Code: MEE1027	INSTRUMENTATION AND CONTROL ENGINEERING	L	T	P	J	C
Pre-requisite : Nil		2	0	2	4	4

Module	Topics	L Hrs	SLO
1	**Introduction to Measurement systems** - Sensors, Transducers, classification, static and dynamics characteristics, errors, transduction principles.	3	2,5
2	**Measurement of Motion, Force and Torque** - Displacement and speed measurement for translational and rotation systems using potentiometers, LVDT and RVDT, Encoders, accelerometers and gyroscopes. Force and Torque measurements using strain gauges and piezoelectric pickups.	5	2,5
3	**Measurement of temperature, pressure and flow** - Temperature measurement using Thermistors, RTD, Thermocouple and semiconductor sensors. Pressure measurement using gage, manometers, bellows, diaphragm, differential pressure transmitter. Flow measurement using Venturi-tubes, Rotameters and anemometers.	5	2,5
4	**Signal conditioning and data acquisition** - Basic signal conditioning – bridges, amplifiers, filters, monitoring and indicating systems and data acquisition systems.	3	2,5,17
5	**Modelling and representation of systems** - Model of a system, Concept of transfer function, block diagram and state space, Modelling of basic physical systems.	4	2,5,17
6	**Control concepts** - Open loop and closed loop systems with examples, controller design, and performance measurements-Design of P, PI, PD and PID controllers.	4	2,5
7	**Stability analysis** - Concept of poles and zeros, Stability analysis of system using root locus, Routh Hurwitz criterion and Phase and gain margins.	4	2,17
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, Video Lectures, Industrial visits and Guest Lectures.			
Laboratory 1. Study, development and calibration of measuring instruments for displacement, speed, torque, force, temperature, pressure, flow, fluid level etc. 2. Control of DC motor, stepper motor and servomotor. 3. Demonstration of PID control system. 4. Use of MATLAB for control system simulation (Control Systems Toolbox) - Modeling of physical systems using Simulink.		**30**	2,5,6, 9,17
Project • Generally a team project [Maximum of 3 members only]. • Concepts studied should have been used. • Down to earth application and innovative idea should have been attempted. • Assessment on a continuous basis with a minimum of 3 reviews. **Sample Projects:** 1. Design and development of a temperature measuring system for a furnace. 2. Development of roughness measurement system using displacement sensors. 3. Design and implementation motion control system for lathe machine bed.		**60** [Non-Contact Hours]	2,6,9, 11,16, 17,18

4. Development of vibration measuring system for heavy machinery. 5. Design and development of monitoring and control system for steam turbine.		

Text Book

1. W. Bolton (2015), Instrumentation and Control Systems, Newnes-Elsevier publication, Second edition.

Reference Books

1. Ernest O. Doeblin (2004), Measurement Systems: Application and Design, 5th Edition, Tata McGraw-Hill.
2. Katsuhiko Ogata (2010), Modern Control Engineering, 5th Edition, Prentice Hall of India Pvt. Ltd.
3. Patranabis D (2011), Instrumentation and Control, PHI Learning Pvt. Ltd.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Compiled by	Prof. S. Senthil Kumar Prof. D. Saravana Kumar

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Course Code: MEE1030	ROBOTICS	L	T	P	J	C
Pre-requisite : Nil		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**Introduction to Industrial robot -** History of Robotics –Basics components of Robotics system – DOF and types of joints – Work space – Robot precession - Types of robotics configurations – Types of robotics drives – Basic motion of robot manipulator – Harmonics drives – Economics aspects of robotics system in industrial automations.	4	1,2
2	**Robot end effetor -** Types of end effector - Mechanical gripper – types of mechanical grippers – magnetic gripper – Vacuum gripper – Adhesive gripper – other special grippers – RCC –Tools – painting gun – welding torch –design of mechanical gripper.	4	1,2,6
3	**Robot control system and Robot kinematics -** Basic control system concepts – Control system analysis – Robot actuation and feedback - Manipulators - Position analysis and finite rotation and translation – Homogeneous matrices – forward and inverse kinematics – DH representation.	4	1,5,7
4	**Manipulator Trajectory planning -** Point-to-point and continuous path planning – trajectory planning – Cartesian space – joint space – bending path – problems in trajectory planning.	4	1,5,7
5	**Sensor in robotics -** Range sensing, Triangulation, structured light approach, Light-of-flight range finder – Proximity sensing: Inductive, Hall-effect, capacitive and ultrasonic sensor –Touch sensing – Force and Torque sensing.	4	1,2
6	**Machine vision system -** Introduction to Machine vision – functional block diagram of machine vision system - Sensing and Digitizing – Image processing and analysis.	4	1,2
7	**Robot programming -** Classification of robotics language – instruction set in Vel language - simple robot in palletizing and de- palletizing – simple robot program in robot arc welding.	4	1,5,7
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
	# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.		
Project • Generally a team project [Maximum of 5 members only]. • Concepts studied should have been used. • Down to earth application and innovative idea should have been attempted. • Assessment on a continuous basis with a minimum of 3 reviews. **Sample projects:** • Two link manipulator control. • Robot end-effector design. • Computing trajectory. • Machine vision based actuation. • Programming industrial for dedicated application with system integration parts.		**60** [Non Contact Hours]	2,6,9, 11,16, 17,18

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Text Book

1. Mikell P. Groover, Mitchell Weiss (2013), Industrial Robotics Technology – Programming and Applications, McGraw Hill Edition 2.

Reference Books

1. S. R. Deb, SankhaDeb (2009), Robotics Technology And Flexible Automation, McGraw Hill Edition.
2. Fu, K.S., Gonzalez, R.C. and Lee, C.S.G. (2008), Robotics: Sensing, Vision and Intelligence , Tata McGraw-Hill, New Delhi.
3. Craig, John. J. (2002), Introduction to Robotics: Mechanics and Control , Second Edition, Pearson Education, New Delhi.
4. Niku, Saeed.B (2005), Introduction to Robotics: Analysis, Systems, Applications, Prentice Hall of India Pvt. Ltd , New Delhi.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Course Code : MEE2007	CAD/CAM	L	T	P	J	C
Pre-requisite : MEE1007		2	0	2	4	4

Module	Topics	L Hrs	SLO
1	**Introduction:** Definition and scope of CAD/CAM- Computers in industrial manufacturing, design process-Computer Aided Design (CAD)-Computer Aided Manufacturing (CAM)-Computer Integrated Manufacturing (CIM) - Introduction to Computer graphics -Raster scan graphics-Co-ordinate systems.	4	1,2,6,9
2	**Graphics and computing standards -** Data base for graphic modeling-transformation geometry-3D transformations –Clipping-hidden line removal-Colour-shading-Standardization in graphics- Open GL Data Exchange standards – IGES, STEP - Graphic Kernal system (GKS).	4	1,2,6,9
3	**Geometric modelling -** Geometric construction methods-Constraint based modeling- Wireframe, Surface and Solid – Parametric representation of curves, solids & surfaces.	4	1,2,6,9
4	**CNC Machine Tools -** Introduction to NC, CNC, DNC - Manual part Programming – Computer Assisted Part Programming – Examples using NC codes- Adaptive Control – Canned cycles and subroutines – CAD/ CAM approach to NC part programming – APT language, machining from 3D models.	4	1,2,6,9
5	**Role of information systems in manufacturing -** Discrete part manufacture-information requirements of a production organization-manufacturing strategies-Integration requirement - Group technology-coding-Production flow analysis-computer part programming-CAPP implementation techniques.	4	1,2,6,9
6	**Introduction to FEA concepts** – Nodes -Meshing – Pre and Post processing – Modal analysis – Stress analysis – Steady state and Transient analysis.	4	1,2,6,9
7	**Automated manufacturing systems -** Flexible Manufacturing systems (FMS) – the FMS concepts – transfer systems – head changing FMS – Introduction to Rapid prototyping, Knowledge Based Engineering, Virtual Reality, Augmented Reality –automated guided vehicle-Robots-automated storage and retrieval systems - computer aided quality control-CMM-Non contact inspection methods. **Communication and Expert systems in CIM -** Networking standards in CIM Environment – Network structure – Network architecture – TCP/IP, MAP- Integration of CAQC with CAD and CAM-CIM Implementation-Lean manufacturing.	4	1,2,6,9
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, Video Lectures, PPTs, Industrial Visits and Guest Lecture by Experts from Industry			
Laboratory 1. Plane stress/Plane strain analysis. 2. Model analysis of different structures.		**30**	1,2,3,5, 6,7,14, 17,18, 20

3. Steady state thermal analysis. 4. Transient thermal analysis. 5. Flow analysis. 6. Thermo-mechanical analysis. 7. CNC Milling program involving linear motion and circular interpolation. 8. CNC Milling program involving contour motion and canned cycles. 9. CNC Milling program involving Pocket milling. 10. Diagnosis and trouble shooting in CNC machine. 11. CNC code generation using any CAM software. 12. Simulation of machining operations using any CAM software. 13. Route sheet generation using CAM software. **14.** Generation of CNC programming and machining using Master Cam.		
Project • Generally a team project [Maximum of 3 members only] • Concepts studied should have been used. • Down to earth application and innovative idea should have been attempted • Assessment on a continuous basis with a minimum of 3 reviews. **Sample projects:** 1. Real time component analysis. 2. Parametric optimization. 3. Fatigue analysis. 4. Path planning. 5. Tolerance analysis. 6. Generation of CNC programming using DXF file format using Wire EDM. 7. Concurrent costing using DFMA. 8. Industrial robot programming. 9. Contact and Non - contact automated inspection. 10. Generation of STL file format for the given component**.**	**60** [Non-Contact Hours]	2,6,9, 11,16, 17,18

Text Book

1. P.N.RAO (2010), CAD/CAM: Principles and Applications -3rd Edition, Tata McGraw Hill, India.

Reference Books

1 Mikell P. Groover (2005), Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education.

2. James A. Rehg, Henry W. Kraebber (2002), Computer Integrated Manufacturing, Pearson Education.

3. Ibrahim Zeid (2005), Mastering CAD/CAM, Tata McGraw Hill International Edition4.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Compiled by	Prof. R. Oyyaravelu Prof. A. Deepa Prof. S. Jeyanthi

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Course Code : MEE2008	PRODUCT DESIGN FOR MANUFACTURING	L	T	P	J	C
Pre-requisite : MEE1007		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**Product Design:**Introduction to Product design: Asimow's Model - Product design practice in Industry - Industrial design - Aesthetics in product design. Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design.	4	1, 2, 5,6, 15,17
2	**Material Selection:** Physical and Mechanical Properties of Engineering Materials, Selection of Materials, Selection of Shapes, Strength consideration in product design, Design for stiffness and rigidity: Material savings in design - Ribs, corrugations, Laminates and Members. Case Studies- I.	4	1, 2,5, 6, 10, 15, 17
3	**Manufacturing Process Selection:** Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Co-selection of Materials and Processes, Case Studies – II.	4	1, 2, 5,6, 17,18
4	**Assembly Process Selection:** Review of Assembly Processes, Design for Welding, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Plastics, Design for Heat Treatment. Case Studies-IV.	4	1, 2,5, 6, 0,17
5	**Use of Computer Aided Tools:** Role of computers in Product design and manufacturing: CAD/CAM softwares - product life cycle - design process – CIM - Collaborative manufacturing. Computer aided process planning.	4	1, 2,5, 6,10, 17
6	**Design for Manufacture and Assembly:** Design for manufacturing and Assembly - principles of DFMA and applications (Boothroyd/ Dewhurst Method – case studies using DFMA software.)	4	1, 2,5, 6,10, 17
7	**New Product Development:** Supporting techniques for new product development processes such as quality function deployment and quality engineering and Taguchi Method.	4	1, 2,6 10, 17
8	**Contemporary Discussion**	2	2
	Total Lecture Hours		
	# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts.	**30**	
	Project • Generally a team project [Maximum of 3 members only]. • Concepts studied should have been used. • Down to earth application and innovative idea should have been attempted. • Assessment on a continuous basis with a minimum of 3 reviews. **Sample projects:** • DFMA of white good industry products. • DFMA of engineering products. • DFMA of new products. • DFMA of furniture products.	**60** [Non-Contact Hours]	5,6,9, 17,18

Text Book

1. A.K. Chitale, R.C. Gupta (2013), Product Design and Manufacturing, Sixth Edition, Printice –Hall of India.

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Reference Book

1. Boothroyd, G., Peter Dewhurst, Winston A. Knight (2010), Product Design for Manufacture and Assembly, Third Edition, CRC Press, Taylor & Fancis.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Compiled by	Prof. C.D. Naiju Prof. K. Janardhan Reddy

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Course Code : MEE2009	TRIBOLOGY	L	T	P	J	C
Pre-requisite : MEE1002, MEE1004		2	1	0	0	3

Module	Topics	L Hrs	SLO
1	**Introduction to Tribology -** Tribology in Design - Mechanical design of oil seals and gasket - Tribological design of oil seals and gasket, Tribology in Industry (Maintenance).	4	1, 2
2	**Friction -** Laws of friction - Stick-slip phenomenon - Friction characteristics of metals and non-metals - Ploughing theory of friction - Measurement of friction. **Wear** - Wear mechanisms – Interfacial wear and Chemical wear- Wear measurements - Ferrography and oil analysis.	4	1,2
3	**Lubrication and Bearings:** Lubrication types, Regimes, Basic Modes of Lubrication, Properties of Lubricants, Lubricant Additives, Bearing Terminology – Sliding contact bearings – Rolling contact bearings, Comparison between Sliding and Rolling Contact Bearings.	4	1,2
4	**Hydrodynamic Lubrication:** Fluid film in simple shear – Mechanism of pressure development in a convergent film – pressure induced and velocity induced flows - Reynolds equation for fluid film lubrication – Slider bearing- Load carrying capacity – Journal bearing – Pressure development. Squeeze film lubrication.	5	2,5,6
5	**Lubrication of bearings:** Long bearing and short bearing approximations - Load carrying capacity – Sommerfeld Number – Friction – Petroff's equation – Oil flow and Thermal equilibrium.	4	2,5,6
6	**Nanoscale Tribology:** Interatomic Interactions, Atomic Force Microscope (AFM), Challenges of Tribological Testing at Small Scales.	4	1,2
7	**Tribological testing and applications:** Common Geometries, Instrumentation and Methods used for Testing, Influences of Test Parameters – Tribology in metal cutting – Automotive Tribology.	3	1,2
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	

 # Mode: Use of physical and computer models to lecture, Visit to Industry and study the various types of bearings, gear boxes, seals and other equipment. Min of 2 lectures by industry experts.

Tutorial — **15** — 1,2,5,6, 9,14

- A minimum of 3 problems to be worked out by students in every tutorial class.
- 5 problems per Tutorial Class to be given as homework.

Tutorial class for Module 2 (2 hours)
Tutorial class for Module 3 (4 hours)
Tutorial class for Module 4 (5 hours)
Tutorial class for Module 5 (4 hours)

For modules 1, 6, 7 and 8 digital assignments are to be given focusing on latest developments in the area.

Text Book

1. Gwidon Stachowiak, Andrew W Batchelor (2013), Engineering Tribology, Butterworth-Heinemann.

Reference Books

1. Prasantasahoo (2005), Engineering Tribology, PHI Learning.
2. Bernard J. Hamrock, Steven R. Schmid, Bo O. Jacobson (2004), Fundamentals of Fluid Film Lubrication , CRC Press.
3. Bharat Bhushan (2013), Introduction to Tribology, John Wiley & Sons.
4. A. Sethuramiah (2003), Lubricated Wear: Science and Technology, Elsevier.

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Course Code : MEE2010	DESIGN OF COMPOSITE MATERIALS	L	T	P	J	C
Pre-requisite : MEE1005		2	1	0	0	3

Module	Topics	L Hrs	SLO
1	**Introduction:** Definitions: Composites, Multiscale Composites and Nanocomposites, Reinforcements and Matrices, Properties of these composites in comparison with standard materials.	2	1, 3
2	**Applications:** Applications of metal, ceramic and polymer matrix composites, Multiscale and nano composites, Hybird composites and Sandwich composites, self reinforced composites and carbon/carbon composites.	3	1,3
3	**Reinforcement and matrix processing methods:** Methods of processing and manufacturing nano-fibres and fibres, dispersoids, single walled and multi-walled carbon nanotubes, Methods of processing thermosets and thermoplastic matrices, Ceramics and metallic matrix materials and fibres, Surface treatments for fibres and other reinforcements, Role of coupling agents on the interfacial adhesion.	5	1,2,3
4	**Composites, multiscale composites and nanocomposites manufacturing:** Wet lay-up and dry lay-up, Open contact molding, Pressure based and vacuum based manufacturing techniques, Thermoplastic and Thermoset based composite manufacturing techniques, Filament winding, Metallic and Ceramic composites manufacturing, Hybrid Composites and hybrid techniques to manufacture composites, Sandwich composites, Quality control.	4	1, 2
5	**Mechanical performance:** Influence of interface on mechanical properties of composite, Mechanical Testing: Tension, compression, flexure, buckling, shear, ILSS, torsion, impact, fatigue. Typical fracture processes; Review of fracture mechanics methods and application to composites. Fatigue damage – Damage tolerance, Reliability and durability of composites, Multiple Causes of Failure, Environmental Effects on Composites.	4	1
6	**Mechanics principles:** Mechanics principles of micromechanics, meso-mechanics and macro-mechanics, Types of Laminates, Stacking Sequence, Plate Stiffness and Compliance, Strains, Computation of Stresses, Coupling and balancing, Design Using Carpet Plots, Hygro-thermal Stresses, First Ply Failure and Last Ply Failure, Progressive failure, Failure modes and failure theories for composites.	4	1,3
7	**Assembly and Composite Products:** Smart composites, Joints and assembly of composites, Design for assembly and environment, Materials selection principles in composites, Case studies in design and development of composite parts, boats, pressure vessels, automotive parts, aerospace parts, electronics parts and composites for space vehicles.	6	2, 4
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry and study the composites equipment, Min of 2

lectures by composites industry experts.		
Tutorial Tutorial class for Module 1 (2 hours) Tutorial class for Module 2 (3 hours) Tutorial class for Module 3 (3 hours) Tutorial class for Module 4 (2 hours) Tutorial class for Module 5 (2 hours) Tutorial class for Module 6 (2 hours) Tutorial class for Module 7 (1 hour)	**15**	5,9, 14,17

Text Book

1. PK. Mallick (2007), Fibre Reinforced Composites, Materials, Manufacturing and Design, 3rd Edition, CRC Press.

Reference Books

1. K.K. Chawla (2012), Composite Materials, Springer-Verlag, New York, 3rd Edition.
2. Sanjay Majumdar (2001), Composite Manufacturing- Materials, Product and Process engineering, CRC Press.
3. ASM Handbook of Composites, Vol 21: Composites, ASM International, 2001.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Compiled by	Prof. K. Padmanabhan Prof. R. Narayanan

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Course Code : MEE2011	WELDING ENGINEERING	L	T	P	J	C
Pre-requisite : MEE1007		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	Power sources - Classification of welding processes - heat sources, power sources, arc characteristics, V-I relationship, different types of electrodes, ingredients and function of electrode coverings, types of weld joints.	4	2, 4
2	Fusion welding processes - Shielded metal arc welding, TIG welding, MIG welding, Submerged arc welding, Electron beam, laser beam welding, plasma arc processes, underwater welding processes.	4	2,6
3	Solid state welding processes - Resistance, friction, friction stir, ultrasonic, induction pressure, diffusion welding processes, explosive welding.	4	17,11
4	Temperature Distribution - Heat flow - temperature distribution - cooling rates - influence of heat input, joint geometry, plate thickness, preheat, significance of thermal severity number.	4	2,14
5	Solidification - Epitaxial growth - weld metal solidification - columnar structures and growth morphology- effect of welding parameters - absorption of gases - gas/metal and slag/metal reactions.	4	2,8
6	Weldability of low alloy steels, welding of stainless steels use of Schaffler and Delong diagrams, welding of cast irons - Welding of Cu, Al, Ti and Ni alloys – processes.	4	2,8
7	Difficulties, microstructure changes, defects and remedial measures in the welding processes.	4	6,14
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts

Project

Generally a team project of Five.

Concepts studied in different Modules, as relevant, should have been used.

Report in Digital format with all drawings using software package to be submitted.

Sample Projects:

1. Investigate the microstructure at the weld zone of AISI 304 obtained by SMAW.
2. Determine the microstructure and hardness across the weldment of dissimilar weld joints.
3. Estimate the tensile strength of stainless steel welds produced by gas tungsten arc welding process. Compare the same with the base metal.
4. Study the effect of welding current on the heat input during GTA welding of Ni based super-alloy.
5. Study the effect of welding speed on the depth of penetration during the GTA welding of Ferritic stainless steel.

60 [Non-Contact Hours] | 5,6,17, 18

Text Book

1. Lancaster L.F (2013),The Physics of Welding: International Institute of Welding, Pergamon Press.

Reference Books

1. Cornu. J. (2004), Advanced Welding Systems, Volumes I, II and III, JAICO Publishers.
2. Parmer R.S (2005), Welding processes, Khanna publishers.

3. Srinivasan N.K (2004), Welding Engineering,", Khanna publishers. 4. Linnert G. E. (2015), Welding Metallurgy, Volume I and II, 4th Edition, AWS. **5.** Sindo Kuo (2003), Welding Metallurgy, Wiley Publishing, II Edition.	
Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. N. Arivazhagan Prof. R. Padmanabhan

Course Code : MEE2012	MANUFACTURING AUTOMATION	L	T	P	J	C
Pre-requisite : MEE1007		2	0	2	4	4

Module	Topics	L Hrs	SLO
1	**Factory Automation**: Basic concepts of automated system, Advanced automated functions, Levels of automation.	3	1, 2, 6
2	**Industrial Hydraulics:** - Principles of hydraulics, Hydraulic fluids, Filtration technology, Hydraulic pumps, Hydraulic valves, and hydraulic actuators, Proportional valves.	3	1, 2, 6
3	**Hydraulic Systems**: Design considerations for hydraulic circuit, Standards in circuit diagram representation, Power pack design layout, Basic hydraulic circuits such as regenerative circuits, sequencing circuit, meter in and meter out circuit, Design of reservoir based on heat transfer considerations, Design of accumulators and intensifiers, Selection of standard components for hydraulic circuits.	5	6, 8
4	**Pneumatic Systems:**Operational principles and application, air compressors, Pneumatic cylinders and air motors, Pneumatic valves, Design of pneumatic circuits, hydro-pneumatic, Control in pneumatic system.	3	6, 8
5	**Design of Fluid Power Circuit**: Design method consideration for sequential circuits - intuitive circuit design method - cascade method - sequential logic circuit design using KV method - compound circuit design -step counter design.	5	6, 8
6	**Programmable Logic Controllers:** PLC Hardware- Electrical Design and Construction - Logical Sensors - Presence detection- Continuous Sensor- continuous actuators- PLC operation - Latches, Timers, Counters, Analog Inputs and Outputs – PLC- programming- Programming Methods- Design Cases.	5	1, 6, 8
7	**Communication Networking:** Remote Monitoring System - Serial Communication – Net Working - Network standards - Human Machine Interfaces.	4	4, 6, 8
8	**Contemporary Discussion**	2	2
Total Lecture Hours # **Mode:** Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts		**30**	
Laboratory o Advance monitoring for continuous casting machines in steel factory. o Control solutions for process involving high temperature applications. o Design a robust panel PC for intelligent machining. o Adaptive control automation for a given process. o Power monitoring of a manufacturing system. • Design an energy saving systems for a manufacturing system.		**30**	2,5,6, 9,14, 18,19, 20
Project # Generally a team project [5 to 10 members] ## Assessment on a continuous basis with a minimum of 3 reviews. **Sample Projects:** • Design an in-line automation strategy that suits todays industrial custom automated		**60** [Non-contact hrs]	5, 6, 7, 14, 17, 18, 19, 20

inspection methods. • Design a pick-n-place stations that provide part inspection, sorting and packaging. • Design an economical seamless part changing system. • One size fits most of the applications. • Design a system which operates with minimal human interface.		

Text Book

1. Hugh Jack (2005), Automating Manufacturing Systems with PLCs, Free Software Foundation.

Reference Books

1. Mujumdar S.R (2002) , Oil Hydraulic Systems: Principles and Maintenance,. Tata McGraw-Hill Education.
2. Mujumdar S.R (2002), Pneumatic System, Tata McGraw Hill.
3. W. Bolton (2011), Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson.
4. D. A. Bradley, D.Dawson, N.C. Burd, A.J. Loader (2004), Mechatronics - Nelson Thrones.
5. W. Bolton (2006), Programmable Logic Controllers, Elsevier Newnes.
6. James L.Johnson (2003), Introduction to Fluid power, Delmar Thomson Learning Inc.

Mode of Evaluation	Digital Assignments / Surprise Tests/ CAT/FAT
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Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. M. Giriraj Prof. Giridharan

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Course Code : MEE2013	MODELING AND SIMULATION OF MANUFACTURING SYSTEMS	L	T	P	J	C
Pre-requisite : MEE1007		3	0	0	4	4

Module	Topics	L Hrs	SLO
1	**Introduction to System Simulation:** Introduction to system simulation – Applications – Discrete and Continuous simulation – Simulation models – Simulation procedure – Simulation Examples – General Principles - Simulation software.	6	1,2,11, 14
2	**Mathematical and Statistical Models:** Review of basic probability and Statistics – Statistical models in simulation – Selecting input probability distributions.	6	1,2,9
3	**Random-Number Generation:** Properties of random numbers - Generation of Pseudo-Random numbers - Techniques for generating random numbers - Testing of Random numbers.	6	1,2,9
4	**Random-Variate Generation:** Inverse Transform techniques - Convolution method – Acceptance - Rejection techniques.	6	1,2,9
5	**Input modelling:** Data collection – Identifying the distribution with data- Parameter estimation - Goodness of fit tests – Selecting input models without data - Multi Variate and Time Series Input Models.	6	1,2,7, 15
6	**Verification and Validation of Simulation Models**: Model building, verification, and validation - Verification of simulation models - Calibration and validation of models.	6	1,2,3
7	**Applications - Simulation modeling using ARENA:** A packaging line, Modeling machine failures, Assembly operations Batch processing, production/Inventory system.	7	1,2,4,8, 11,14
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**45**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.			
Project ▪ Generally a team project [Maximum 4 members]. ▪ Report in digital format which includes problem & system description, input data collection and analysis, arena model, experimentation & output analysis and conclusions. ▪ Assessment on a continuous basis with a minimum of 3 reviews. **Sample projects:** 1. Simulation methodologies and techniques studied in Modeling and Simulation of Manufacturing Systems are to be applied. 2. Focus on practical real life applications of simulation in manufacturing environment.		**60** [Non-contact hours]	1,2,3,4, 7,8,9, 11,13, 14,16, 17,18, 19

Text Book

1. Jerry banks, John S Carson, Barry L Nelson and David M Nicol (2013), Discrete Event System Simulation, 5th Edition, Pearson Education Asia.

Reference Books

1. Averill M. Law (2014), Simulation modeling and analysis, 5th edition, McGraw-Hill Education.
2. W. David Kelton, Randall P. Sadowski, Nancy B. Zupick (2014), Simulation with Arena, 6th edition, McGraw-Hill Education.
3. Sheldon M. Ross (2012), Simulation, Academic Press, 5th Edition.
4. William J. Stewart (2009), Probability, Markov Chains, Queues, and Simulation: The Mathematical Basis

of Performance Modeling, Princeton University Press.
5. Barry L. Nelson (2010), Mathematics, Stochastic Modeling: Analysis and Simulation, Dover Publications.

Mode of Evaluation	Digital Assignments /Surprise Test /Seminars /CAT/FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. Dega Nagaraju Prof. Jafferson

Course Code : MEE2014	METAL CASTING TECHNOLOGY	L	T	P	J	C
Pre-requisite : MEE1007		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**Moulding Practices -Production of Moulds and Cores:** Introduction to casting and foundry industry; basic principles of casting processes; sequence in foundry operations; Moulding sand and its properties. Carbon dioxide moulding, Moulding Equipment, moulding technique, Patterns and Cores.	4	2,5,6
2	**Melting technology:** Melting furnaces for ferrous and non-ferrous foundries. Electric and fuel fired furnaces. Induction Furnaces; Types of Furnaces, Electromagnetic Stirring, power supplies; Recent developments in energy considerations. Melting practice – ferrous, non-ferrous metals and alloys and composites. Melting practices; Fluxing, inoculation, degassing and grain refinement treatments. Control of pouring temperature Heat treatments of castings, Shop floor melt quality tests.	4	1,2,6, 14
3	**Casting Processes – Detailed study:** Shell moulding, Plaster Mould casting, Squeeze casting, Investment Casting, Die-casting, Centrifugal casting, Stir casting - Fundamental principles, production techniques, characteristics and its applications.	4	2,6,14
4	**Solidification of Casting**: Concept of solidification of metals. Homogenous and heterogeneous nucleation. Growth mechanism. Solidification of pure metals and alloys. Mechanism of columnar and dendritic growth. Solidification time and Chvorinov's rule. Concept of progressive and directional solidifications.	4	2,5,6
5	**Principles of Gating and Risering**: Purpose of the gating system. Components of the gating System and its functions. Design of the gating System. Different types of gates. Gating ratio and its functions. Definition and functions of the riser. Types of risers and their application. Design of the riser - its shape. Size and location. Use of insulating material and exothermic compounds in risers.	4	1,2,6, 14
6	**Design of Casting:** Factors to be considered in casting design. Design consideration in pattern making, moulding techniques and core making and assembly. Cooling stresses and hot spots in casting and modification in casting geometry to overcome them – Modeling and Simulation using Solidcast, Opticast and Flowcast. **Casting Quality Control**: Casting defects and factors responsible for them. Different inspection and testing methods to evaluate the casting. Quality control activities in a foundry.	5	1,2,6, 14
7	**Structure and Properties of Cast Metal:** Detailed study of microstructure, mechanical and other properties of ferrous and non-ferrous metals and alloys and composites. Techniques of strengthening and improving the properties of cast metals and alloys.	3	2,6,14
8	**Contemporary Discussion**	2	2
Total Lecture Hours **# Mode:** Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.		**30**	
Project # Generally a team project of Five. # Concepts studied in Modules 2, 4, 6, 7 should have been used.		**60** [Non-Contact	2,4,5, 6,7

# Down to earth application and innovative idea should have been attempted. # Report in Digital format with all drawings using software package to be submitted. **Sample Projects:** 1. Molten Metal Flow Analysis for Different Casting Processes. 2. Riser Design For Casting a Bracket. 3. Thermal Analysis Of Die Casting Process. 4. Alloy development by stir casting process. 5. Optimization of gating system for reducing the casting defects. 6. Non-destructive testing of casting. 7. Design of Pattern for casting different materials. 8. Melting practices for ferrous and non-ferrous alloys. 9. Development of composite materials by stir casting process. 10. Testing the properties of moulding sand.	Hours]	

Text Book

1. Heine, et. al (2003), Principle of Metal Casting, Tata-McGraw-HiII Publication.

Reference Books

1. Campbell, J., Castings (2003), Butter Worth, Heinemann Publishers.
2. Beeley P.R. (2001), Foundry Technology,Buttersworth.
3. Srinath Viswanathan (2008), Metal Casting ASME Handbook.

Mode of Evaluation	Digital Assignments /Surprise Test /Seminars /CAT/FAT
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Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. G. Sundaramali Prof. Radha

Course Code : MEE2015	NON-DESTRUCTIVE TESTING	L	T	P	J	C
Pre-requisite : MEE1005		2	0	2	4	4

Module	Topics	L Hrs	SLO
1	**Introduction to NDT –** Procedure, testing and evaluation, Visual examination.	2	1, 2, 6, 14, 17
2	**Surface NDT Techniques -** Liquid penetrant testing and magnetic particle testing. Advantages and limitations of each of these techniques.	4	1, 2, 6, 14, 17
3	**Radiographic Testing -** Radiography principle, X-ray films, exposure, penetrameter, radiographic imaging, inspection standards and techniques, Radiography applications, limitations and safety.	5	1, 2, 6, 14, 17
4	**Eddy Current Testing -** Principle, depth of penetration, eddy current response, eddy current instrumentation, probe configuration, applications and limitations.	4	1, 2, 6, 14,17
5	**Ultrasonic Testing -** Properties of sound beam, ultrasonic transducers, inspection methods, flaw characterization technique, immersion testing.	5	1, 2, 6, 14,17
6	**Acoustic emission testing -** Theory of AE sources and Waves, Equipment, Signal Features, Data display, source location, Barkhausen noise, Applications.	4	1, 2, 6, 14, 17
7	**Special / Emerging Techniques -** Leak testing, Holography, Thermography, Magnetic resonance Imaging, Magnetic Barkhausen Effect. In-situ metallography.	4	1, 2, 6 14, 17
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts			

Laboratory 1. Detection of sub surface flaws using Magnetic Particle Testing. 2. Detection of surface flaws using Magnetic Particle Testing. 3. Detection of surface flaws of materials with visible dye. 4. Detection of surface flaws of materials with fluorescent dye. 5. Detection of internal flaws using Ultrasonic testing. 6. Detection of surface and sub surface flaws using Ultrasonic testing. 7. Thickness measurements using Ultrasonic testing. 8. Corrosion survey using Ultrasonic testing. 9. Detection of surface flaws using eddy current testing in nonferrous material . 10. Detection of surface flaws in bore holes using eddy current testing. **11.** Conductivity variation measurement using eddy current testing. **12.** Dimensional variations measurement using eddy current testing.	**30**	1,2,6, 14,17
Project # Generally a team project of Five. # # Concepts studied in different Modules, as relevant, should have been used. ### Report in Digital format with all drawings using software package to be submitted. **Sample Projects:** 1) Selection of the best method for non-destructive detection of pores in cast sticks of a nickel base superalloy. 2) Designing a suitable non-destructive method for ascertaining the soundness of	**60** [Non-Contact Hours]	1,2,5,6, 14,17

ceramic-metal joints. 3) Designing a comprehensive non-destructive testing programme for manufacture of rocket motor casings. 4) Formulation of the best combination of non-destructive test techniques for comprehensive testing of end fitting forgings. 5) Design of a suitable non-destructive test procedure for segregating overheated steel bars from bars properly heated. 6) Design of a suitable non-destructive test method for segregating different grades of steel bars which got mixed up inadvertently during production. 7) Conception of a suitable non-destructive test technique for checking possible embrittlement in a superalloy used in plants for heavy water production. 8) Study of grain size variations in metallic materials, using an appropriate non-destructive test technique.		

Text Book

1. Baldevraj, Jayakumar T., Thavasimuthu M. (2008), Practical Non-Destructive Testing, 3rd edition, Narosa Publishers.

Reference Books

1. Paul E Mix (2005), Introduction to nondestructive testing: a training guide, Wiley, 2nd edition New Jersey.
2. Ravi Prakash (2010), Nondestructive Testing Techniques, New Age International Publishers, 1st rev. edition.

Mode of Evaluation	Digital Assignments /Surprise Test /Seminars /CAT/FAT
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Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. S. Devendiran Prof. M. Senthil Kumar

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Course Code : MEE2016	RAPID MANUFACTURING TECHNOLOGIES	L	T	P	J	C
Pre-requisite : MEE1007		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**Introduction to Rapid Manufacturing**,: Additive Manufacturing evolution, Additive manufacturing processes and their relationship with subtractive manufacturing, Advantages of RM. Generalized rapid manufacturing process chain, Rapid Tooling –Benefits, Applications.	4	2, 5, 11, 17
2	**Data Processing for Rapid Manufacturing:** Conceptualization and CAD model preparation, data formats – Conversion to STL file format, Fixing the STL file, Part orientation, Support structure design, Model Slicing, Direct and adaptive slicing.	4	1, 2, 5, 6
3	**Rapid Manufacturing Processes, Materials and its application:** Sintering, Powder Bed Fusion, extrusion, jetting, Photopolymerization, direct-write, sheet lamination, directed-energy deposition and the latest state of the art. Multiple Materials, Hybrids, Composite Materials, current and future directions.	4	1, 2, 17
4	**Post-Processing:** Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.	4	1, 2, 17
5	**Design for Rapid Manufacturing (DFRM):** Core DFAM Concepts and Objectives: Complex Geometry, Customized Geometry, Integrated Assemblies and Elimination of Conventional design for manufacture (DFM) Constraints. RM Unique Capabilities, Exploring Design Freedoms and Design Tools for RM.	4	1, 2, 17
6	**Guidelines for process selection:** Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control.	4	4, 5, 6, 18
7	**Rapid Tooling:** Direct tooling & Indirect Tooling methods, Reaction Injection Molding, Wax Injection Molding, Vaccum Casting, RTV Silicone Rubber Molds, Spin-Casting, Cast Resin Tooling.	4	4, 5,6, 17
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts			
Project # Generally a team project of Five. # # Concepts studied in different Modules, as relevant, should have been used. ### Report in Digital format with all drawings using software package to be submitted. **Sample Projects:** • Projects on CAD data generation for 3D printing using various tools including: various scanning and reverse engineering techniques and related software. • Projects on CAD data processing such as STL file corrections, orientation optimization, support and toolpath generation for economically producing the components with desired properties. • Design and fabrication of working models for the conceptual testing applications. • Build complex engineering assemblies in plastic material with less process	**60** [Non-Contact Hours]	1,5,6, 14,15

planning. • Redesign the existing locomotive key-components for weight reduction without effecting the functionality that can be produced only by additive manufacturing.		

Text Book

1. Ian Gibson, David W. Rosen, Brent Stucker (2015), Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 2nd Ed., Springer Science & Business Media.

Reference Books

2. Dongdong Gu (2014), Laser Additive Manufacturing of High-Performance Materials, , Springer Publications.
3. Ali K. Kamrani, Emad Abouel Nasr (2**006), Rapid Prot**otyping: Theory and Practice, Springer.
4. D.T. Pham, S.S. Dimov (2001), Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer.
5. Andreas Gebhardt (2011),Understanding Additive Manufacturing, Hanser Publishers.

Mode of Evaluation	Digital Assignments / Surprise Tests/ CAT/FAT
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Compiled by	Prof. K. Raja Prof. A.S.S. Balan Prof. Raghu Kiran

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Course Code : MEE2019	MATERIAL CHARACTERIZATION TECHNIQUES	L	T	P	J	C
Pre-requisite : MEE1005		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**Basic crystallography and Need for Material Characterization** - Unit cells, Crystal structure, Primitive and Non- primitive cells, Symmetry elements and point group notations, Streographic projections - Need for Material Characterization - Methodology for Material Characterization and Analysis.	2	2
2	**Diffraction and Imaging** - Phenomena of diffraction; Radiation-matter Interactions and response signals; X-ray diffraction: powder diffraction, phase identification, Scherrer formula, strain and grain size determination ; Fundamentals of Imaging: magnification, resolution, depth of field and depth of focus, aberration and astigmatism ; X-Ray reflectivity.	3	1, 2,14
3	**Optical microscopic Techniques** - Special microscopy techniques and applications: Bright field and dark field imaging; confocal microscopy; interference microscopy; polarized light microscopy; phase contrast microscopy. Scanning near field laser microscopy; Image processing and quantification.	3	1, 2, 14
4	**Optical Spectroscopic Techniques** - Principle, Working and Result Analysis of Fourier Transformation Infra-Red Spectroscopy; Raman Spectroscopy; UV-Vis Absorption Spectroscopy; Photoluminescence Spectroscopy - Ellipsometer Spectroscopy.	3	1, 2,14
5	**Electron Microscopic Techniques** - Basics of Electron Microscopy - Introduction - Principle of SEM, Instrumentation, Contrast formation, Operational variables, Specimen preparation, imaging modes, Applications, Limitations – FE-SEM , FIB, EDAX. TEM - Introduction, Instrumentation, Specimen preparation: Mechanical thinning, electrochemical thinning, ion milling, sputter coating and carbon coating, replica methods. Image modes - mass density contrast, diffraction contrast, phase contrast, Applications, Limitations.	8	2, 14
6	**Thermal analysis** - Instrumentation, experimental parameters, Differential thermal analysis, Differential Scanning Calorimetry, Thermogravimetry, Dilatometry, Dynamic mechanical analysis- Basic principles, Instrumentation, working principles, Applications, Limitations.	4	2,14
7	**Advanced Characterization Techniques** - Rutherford back scattering (RBS), Scanning Tunneling Microscopy (STM), Atom Force Microscopy (AFM) and different operational modes, X-ray Photoelectron Spectroscopy (XPS): Auger Electron Spectroscopy (AES), Dynamic SIMS and static SIMS, HR-TEM , EF-TEM, EELS - Characterization of Fluids - Viscosity, Relative density, thermal conductivity.	5	2,14
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.			
Project # Generally a team project of Five.		**60** [Non-	5,9,14, 17

# Concepts studied in Modules 2, 4, 6 should have been used. # Down to earth application and innovative idea should have been attempted. # Report in Digital format with all drawings using software package to be submitted. **Sample Projects:** 1. Analysis and data interpretation of SEM Images. 2. Analysis and data interpretation of TEM Images. 3. Interpreting and analyzing chemical composition from XPS. 4. Investigation of optical properties through UV-Vis spectrophotometer. 5. Chemical composition determination using FTIR. 6. Structural investigations using XRD. 7. Investigation of optical properties through photoluminescence. 8. Ellipsometer investigation of materials. **9.** Microfluids characterization.	Contact Hours]	

Text Book

1. Yang Leng, (2013), Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, 2nd Edition, Wiley Publications.

Reference Books

1. D. Brandon and W.D. Kaplan (2008), Microstructural Characterization of Materials –John Wiley and Sons.
2. S. Zhang, Lin Li and Ashok Kumar (2009), Materials Characterisation Techniques, CRC Press.
3. B.D.Williams and C.B.Carter (2009), Transmission Electron Microscopy –Springer.
4. E.J. Mittemeijer (2010), Fundamentals of Materials Science - the microstructure-property relationship using metals as model systems, Springer.

Mode of Evaluation	Digital Assignments /Surprise Test /Seminars /CAT/FAT
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Course Code : MEE2020	METAL FORMING THEORY AND PRACTICE	L	T	P	J	C
Pre-requisite : MEE1007		3	0	0	0	3

Module	Topics	L Hrs	SLO
1	**Theory of Plasticity** - stress tensor – hydrostatic & deviator components of stress – flow curve – true stress strain – yielding criteria – yield locus – octahedral shear stress and shear strains – invariants of stress strain – slip line field theory - plastic deformations of crystals.	6	1,5
2	**Fundamentals of Metal working** - Classification of forming processes, mechanics of metal working, temperature in metal working, strain rate effects, metallurgical structure, friction and lubrication, deformation zone geometry, hydrostatic pressure, workability, residual stresses.	6	1,5
3	**Forging process** – classification, Forging in plane strain, forging equipment, open die forging, closed die forging, calculation of forging loads in closed die forging, Forging defects, powder metallurgy forging, residual stresses in forgings.	6	1,5
4	**Rolling**– classification - rolling mills - rolling of bars & shapes – rolling forces, analysis of rolling – defects in rolling- theories of hot & cold rolling – torque power estimation.	6	1,5
5	**Extrusion** - classification - equipment – deformation lubrication and defects – analysis – hydrostatic extrusion – tube extrusion - Drawing, rod & wire drawing, analysis of wire drawing, tube drawing processes, analysis of tube drawing, residual stresses in rod, wire and tubes.	6	1,5
6	**Sheet metal forming** – methods – shearing and blanking, bending, stretch forming – deep drawing – forming limit criteria – defects in formed parts.	6	1,5
7	**Unconventional Forming Methods** - Explosive forming, Electro hydraulic forming – magnetic pulse forming – super plastic forming – electro forming – fine blanking – P/M forging-Isothermal forging – HERF.	7	1,5
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**45**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry expert.s

Text Book

1. George E Dieter (2007), Mechanical Metallurgy, Tata McGraw Hill.

Reference Books

1. Wagoner, R. H., and Chenot, J.L (2001), Metal Forming Analysis, Cambridge University Press,
2. Henry S. Valberg (2010), Applied Metal Forming: Including FEM Analysis, Cambridge University Press.
3. William F. Hosford and Robert M. Caddell (2011), Metal Forming : Mechanics and Metallurgy, Cambridge University Press, 4/e.

Mode of Evaluation	Digital Assignments /Surprise Test /Seminars /CAT/FAT
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Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. A.K. Jeevanatham Prof. Vijayaram

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Course Code : MEE2022	POWER PLANT ENGINEERING					
Pre-requisite : MEE1003		L	T	P	J	C
		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**Steam Power Plant:** Site selection, Components and Layout of steam power plant, vapor power cycles. Steam Generators – Classification and Types of Boilers - Fire tube and Water tube boilers - High pressure and Supercritical boilers - Positive circulation boilers - Fluidized bed boiler - Waste heat recovery boiler, Heat Exchangers - Feed water heaters - Super heaters - Reheaters - Economiser - Condenser-Cooling tower.	7	1, 2, 5, 9, 11
2	**Combustion and Firing Methods:** Coal handling and preparation - Combustion equipment and firing methods - Mechanical stokers - Pulverized coal firing systems - Cyclone furnace - Ash handling systems - Electrostatic precipator - Fabric filter and Bag house - Forced draft and Induced draft fans.	4	1, 2, 9,11
3	**Nuclear Power Plants:** Site selection, Components and Layout Principles of nuclear energy - Energy from nuclear reactions - Energy from fission and fuel Burnup - Decay rates and Half - Lives. Boiling water reactor - Pressurized water reactor Pressurized Heavy Water Reactor - Gas cooled reactor - High temperature gas cooled reactor - Fast breeder reactor - Liquid metal fast breeder reactor-reactor materials - Radiation shielding.	4	1, 2, 5, 9, 11
4	**Gas Turbine Power Plants:** Site selection, Components and Layout, Open and closed cycles - Intercooling - Reheating and Regenerating - Combined cycle power plant types.	4	1, 2, 5, 9, 11
5	**Hydro Electric Power Plants:** Site selection, Components and Layout, Classification of Hydro - electric power plants and their applications - Selection of prime movers - Governing of turbine.	3	1, 2, 5, 9, 11
6	**Diesel Engine Power Plant:** Site selection, Components and Layout, Subsystems - Starting and stopping - Heat balance - Lubricating and Cooling startegies - Constraints in operating range.	3	1, 2, 5, 9, 11
7	**Economics of Power Plants:** Cost of electric Energy - Fixed and operating costs - Energy rates - Types tariffs - Economics of load sharing - Load Curves.	3	1, 2, 5
8	**Contemporary Discussions**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts.			
Project # Generally a team project [3 to 5 members]. # Concepts studied in Power Plant Engineering to be applied. # Focus on innovative design for real life application. # Report in digital format with all analyses performed using software. # Assessment on a continuous basis with a minimum of 3 reviews. **Sample Project:**		**60** [Non-contact hrs]	5, 6, 7, 14, 17, 18, 19, 20

1. Analysis of reheat and regeneration cycles. 2. Development of software for reheat and regeneration cycles. 3. Analysis of binary and ternary vapor power cycles. 4. Development of software for binary and ternary vapor power cycles. 5. Analysis of combined power cycle plants with waste heat recovery. 6. Software for Power Plant Economics. 7. CFD analysis of gas turbine and steam turbine blade cooling.		

Text Book

1. P. K. Nag (2013), Power Plant Engineering: Steam and Nuclear, Tata McGraw-Hill Publishing Company Ltd., Fifth Edition.

Reference Books

1. M. M. El-Wakil (2002), Power Plant Technology, McGraw-Hill International Editions.
2. Black and Veatch (2005), Power Plant Engineering, CBS Pub and Distributors, New Delhi.
3. R. K. Rajput (2015), A Text Book of Power Plant Engineering, Laxmi Publications (P) Ltd.

Mode of Evaluation	Digital Assignments /Seminars/Surprise Tests / CATs /FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. A. K. Karthikeyan Prof. Tamil Selvan

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Course Code : MEE2023	GAS DYNAMICS AND JET PROPULSION	L	T	P	J	C
Pre-requisite : MEE1003, MEE1004		2	1	0	0	3

Module	Topics	L Hrs	SLO
1	**Introduction to compressible fluid flow and control volume analysis:** Coefficient of Compressibility - Stagnation state – Critical state - Various regions of flow - Physical significance of Mach number - Mach cone - Differences between Incompressible and Compressible flows. Properties of atmosphere - Effect of Mach number on compressibility, Conservation laws for mass - Momentum and energy in steady flow.	3	1,2,5,9
2	**Isentropic Variable area flows:** Isentropic flow through a variable area duct – Mach number variation - Area ratio as a function of Mach number - Impulse function - Mass flow rate through nozzles and diffusers. Phenomenon of choking – subsonic and supersonic designs - Pressure values for nozzles and diffusers. T-S and H-S diagrams showing Nozzle and Diffuser process.	5	1,2,5,9
3	**Shocks and Expansion waves in compressible flows:** Flow with normal shock waves - Governing equations - Prandtl–Meyer equation - Impossibility of rarefaction shock - Mach number downstream of shock – Property variation across shock - Strength of shock wave - entropy change, Oblique shock-Property relations, Relation between M_x and M_y, θ-β-M relation, Maximum Value of Oblique shock, Detached shock, Prandtl-Meyer Expansion fans.	5	1,2,5,9
4	**Flow through constant area ducts with Friction:** Fanno flow - Fanno curves - Equation and its solution - Variation of flow properties with duct length - Applications. Normal shocks in Fanno flow.	4	1,2,5,9
5	**Flow through constant area ducts with heat transfer:** Rayleigh flow - Rayleigh flow equation - Rayleigh line - Variation of flow properties - Maximum heat transfer – Applications. Normal shocks in Rayleigh flow.	5	1,2,5,9
6	**Aircraft Propulsion:** Air craft propulsion – Types of jet engines - Energy flow through jet engines - Thrust - Thrust power and Propulsive efficiency - Turbojet components - Diffuser compressor - Combustion chamber - Turbines - Exhaust system - Performance of jet engines.	3	1,2,5,9
7	**Rocket Propulsion:** Rocket propulsion – Rocket engines - Basic theory of equation - Thrust effective jet velocity - Specific impulse - Rocket engine performance - Solid and Liquid propellant rockets - Comparison of various propulsion systems.	3	1,2,5,9
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts.			
Tutorials Tutorial class for Module 1 (2 hours)		**15**	1,2,5,9

Tutorial class for Module 2 (3 hours) Tutorial class for Module 3 (3 hours) Tutorial class for Module 4 (2 hours) Tutorial class for Module 5 (2 hours) Tutorial class for Module 6 (2 hours) Tutorial class for Module 7 (1 hour)		

Text Book

1. S.M.Yahya (2012), Fundamentals of compressible flow with Aircraft and Rocket propulsion, 4th edition, New Age International Publisher.

Reference Books

1. J.D.Anderson, Jr (2004), Modern Compressible Flow with Historical Perspective, McGraw-Hill.
2. Babu, V. (2014), Fundamentals of Gas dynamics. John Wiley & Sons.
3. Robert D. Zucker, Oscar Biblarz (2002), Fundamentals of Gas Dynamics, John Wiley & Sons.

Mode of Evaluation	Digital Assignments / Seminars / CAT/FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. Bibin John Prof. Manimaran

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Course Code : MEE2025	FLUID POWER SYSTEMS	L	T	P	J	C
Pre-requisite : MEE1004		3	0	2	0	4

Module	Topics	L Hrs	SLO
1	**Introduction to fluid power -** Hydraulics Vs Pneumatics, Pascal's Law, Basic properties of hydraulic fluids, Basic principle of Pneumatics, Gas laws, ISO symbols.	6	1,5,6
2	**Fluid Power drives -** Types and construction of Hydraulic pumps and motors, Pneumatic power supply source – Compressors, air distribution.	6	1,5,6
3	**Fluid Power Control Components -** Valves – Pressure, direction and flow control valves, proportional and servo valve, Accumulators, Filter Regulator Lubricator(FRL), Actuators.	6	1,5,6
4	**Basic Fluid Power Circuits -** Fail safe circuits, Regenerative circuits, Meter in and Meter out circuits, Accumulator circuits, Pressure intensifier circuit, Counter balance circuit.	6	1,17,18
5	**Fluid Power Circuit Design -** Multi cylinder sequencing circuits, Travel step diagram, Synchronizing circuit, cascade and Karnaugh – Veitch map method.	6	1,6,18
6	**Applications of Fluid Power Circuits -** Low cost Automation, Bottling and Packaging Industry, Material handling and assembly applications, Automotive applications, Car park barriers.	6	1,2,6, 12
7	**Electronic and Electrical controls for Fluid Power Systems -** Electro pneumatics & Electro hydraulics, solenoids, relays, proximity sensors, Programmable Logic Controllers, Ladder diagram, Timers and Counters. **Maintenance and troubleshooting of Fluid Power System -** Maintenance and troubleshooting of Filters and strainers, Reservoir System, sealing devices, Fire-resistant fluids, beta ratio of filters.	7	1,2,17,20
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**45**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.

Laboratory

- Multi cylinder sequencing circuit using trainer kit, Pneumosim/ Hydrosim / Automation studio software PLC.
- Pneumatic circuit design using trainer kit and software.
- Hydraulic Circuit design using trainer kit and software.
- Electro pneumatic and Electro Hydraulic circuit design using trainer kit and software.
- Meter in and Meter out fluid power circuits.
- Determining Cylinder force in various methods of linear motion.

30 1,2,14

Text Book

1. Anthony Esposito (2013), Fluid Power Systems, :Pearson New International edition.

Reference Books

1. James R.Daines (2013), Hydraulics and Pneumatics, 2nd Edition,The Goodheart-Willcox Company, Inc.
2. W.Bolton (2013), Mechatronics, Electronic control systems in Mechanical and Electrical Engineering, Perason Education.
3. Andrew Parr (2011), Hydraulics and Pneumatics, Butterworth and Heinmann.
4. (2015), Festo Basic Pneumatic, Electro pneumatic, Hydraulic text and work books.
5. John Pippenger (2012), Fluid Power Controls, Literary Licensing LLC.

Mode of Evaluation	Digital Assignments / Surprise Tests / Seminars / CATs /FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. DRS Raghuraman Prof. Elango

Course Code : MEE2026	TURBOMACHINES					
Pre-requisite : MEE1003, MEE1004		L	T	P	J	C
		2	0	2	4	4

Module	Topics	L Hrs	SLO
1	**Energy Transfer:** Definition and classification of Turbomachines, Specific work - T-s and H-s diagram - Equation of energy transfer - Losses - Various efficiencies - Effect of reheat - Preheat.	4	1,2,5,9
2	**Cascading:** Aero–Foil section - Cascading of compressor and Turbine blades - Energy Transfer in terms of lift and drag co-efficient for compressor and turbine blades - Variation of lift - Deflection and stagnation pressure loss with incidence.	3	1,2,5,9
3	**Centrifugal Compressors:** Centrifugal fans - Blowers and Compressors - construction details - Inducers - Backward and Radial blades - Diffuser - volute casing stage work - Stage pressure rise - Stage pressure co-efficient - Stage efficiency - Degree of reaction - Various slip factors H-S diagram for centrifugal compressor.	4	1,2,5,9
4	**Axial Compressors:** Axial flow Fans and Compressors - Stage velocity triangles - Blade loading and flow co-efficient - Static pressure rise - H-S diagram - Degree of reaction - Work done factors - Free and Forced Vortex flow performance - Stalling and Surging.	4	1,2,5,9
5	**Radial Turbines:** Inward flow radial turbine stages - IFR Turbine - T-s diagram - and degree of reaction - Steam turbine governing – Features of Steam turbine and Gas turbine.	4	1,2,5,9
6	**Axial Turbines:** Axial turbine stages - Stage velocity triangle - Work - Single stage Impulse Turbine - Speed ratio maximum utilization factor - Multistage velocity compounded impulse - Multi stage pressure compounded impulse - reaction stages - Degree of reaction - Zero reaction stages - Fifty percent reaction stages - Hundred percent reaction - Negative reaction - Free and Forced vortex flow.	4	1,2,5,9
7	**Hydraulic Machines** - Centrifugal pumps – Work done - Head developed - Pump output and Efficiencies - priming - minimum starting speed - performance of multistage pumps - Cavitation - methods of prevention - Pump characteristics - Classification of hydraulic turbines - Pelton wheel - Francis turbine - Kaplan and Propeller turbines - Velocity triangles - Specific speed - Theory of draft tube - Governing - Performance characteristics - Selection of turbines.	5	1,2,5,9
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts.

Laboratory 1. To study the performance of Gear Pump at different discharge pressures. 2. To study the performance of Reciprocating Pump at different discharge pressures. 3. To study the performance of Constant Speed Centrifugal Pump at	**30**	1,9,14

different discharge pressures. 4. To study the performance characteristics of Variable Speed Centrifugal Pump at different speeds and different discharge pressures. 5. To study the performance of Jet Pump at different discharge pressures. 6. To study the performance of Submersible Pump at different discharge pressures. 7. To study the performance of Kaplan Turbine at constant speed, constant load and different vane and blade positions. 8. To study the performance of Francis Turbine at constant speed, constant load and different vane positions. 9. To study the performance of Pelton Turbine at constant speed and constant load conditions.		
Project # Generally a team project of Five. # Report in Digital format with all drawings using software package to be submitted. **Sample Projects:** 1. Fabricate a mini-windmill useful for charging low power devices at home. 2. Perform a CFD analysis of a Hydraulic Turbine. **3.** Dissemble a centrifugal pump and carry out a reverse engineering process.	**60** [Non-contact hours]	2,5,6,9,17

Text Book

1. S.M. Yahya (2002), Turbine, Fans and Compressors, TMH.

Reference Books

1. Dixon, S.L. (2014), Fluid Mechanics and Thermodynamics of Turbomachinery, 7th edition, Elsevier.
2. Kadambi and Prasad (2011), Energy conversion Vol. III – Turbomachines, New Age International.
3. A.H. Church and Jagadish Lal (2000), Centrifugal Pumps and Blowers; Metropolitan Book Co, Pvt. Ltd.
4. Kenneth C.Hall, Robert E.Kielb, Jeffrey P.Thomas (2006), Unsteadyaerodynamics, Aeroacoustics and Aeroelasticity of Turbomachines, Springer, Netherlands.

Mode of Evaluation	Digital Assignments / Surprise Tests / Seminars / CATs /FAT
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Compiled by	Prof. C. G. Mohan Prof. Manavalla Srikanth

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Course Code : MEE3002	FINITE ELEMENT ANALYSIS	L	T	P	J	C
Pre-requisite : MEE2002		2	1	0	4	4

Module	Topics	L Hrs	SLO
1	**Introduction to Finite Element Method** - General description of Finite Element Method – Historical development – Comparison with classical methods – Other numerical methods such as FDM, BEM etc - General procedure of FEM – Application software's in FEM.	3	1,2,7,11
2	**Approximate Solutions to Engineering Problems -** General field problems - GDE formulation - discrete and continuous models – approximate solution as a polynomial - minimization of residue – Weighted residual methods – collocation method, sub domain method, method of least squares and Galerkin method - Variational formulation Ritz method - numerical problems.	4	1,7,12,17
3	**Finite Element Formulations to 1-D problems** – II order problems - Bar Problem – Formulation for the whole domain – Formulation for the sub-domain (finite element) using interpolation polynomial - Nodal approximation using shape function – computing element matrices - Assembly of element matrices – Application of B.Cs – solution – post processing.	4	2,4,7,8
4	**Beam problems** (IV order problems) – B.Cs & loading conditions on to nodes – element matrices - solution and post processing of results – I Dimension problems such as Heat transfer problems, Vibration problems in bar and beams etc.	4	2,4,7,8, 12
5	**Two Dimensional problems** - Discretization: Geometrical approximations – Simplification through symmetry – Element shapes and behaviour – Choice of element types – Simplex - Complex and Multiplex elements – Selection of interpolation polynomials (shape functions) - Convergence requirements – Element shape and distortion – Location of nodes – Node and Element numbering.	5	7,8,12,13
6	**Field problems – scalar and vector variables** – Scalar variable problems such as heat transfer, torsion of non-circular shafts etc – Vector variable problems such as plane stress, plane strain and axi-symmetric problems.	4	13,14,15, 18
7	**Natural coordinate systems** - Derivation of shape functions for various elements – Isoparametric elements – 1D, 2D and 3 D elements - Numerical Integration and its advantages.	4	17,18,19, 20
8	**Contemporary discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Classrooms, Individual Exercises, Team Exercises, Online Quizzes, Online Discussion Forums, Assignments.			
Tutorial (A minimum of 3 problems to be worked out by students in every tutorial class. Another 6 problems per Tutorial Class to be given as homework.) Tutorial class for Module 2 (2 hours) Tutorial class for Module 3 (3 hours)		**15**	1,2,7,9, 12,17,18, 19

Tutorial class for Module 4 (3 hours) Tutorial class for Module 5 (2 hours) Tutorial class for Module 6 (2 hours) Tutorial class for Module 7 (2 hours) Tutorial class for Module 8 (1 hour)		
Project • Generally a team project [Maximum of 3 members only]. • Concepts studied should have been used. • Down to earth application and innovative idea should have been attempted. • Assessment on a continuous basis with a minimum of 3 reviews. *Mechanical Engineering Field Problem solution using ANY commercial software or Open source software*	**60** [Non-contact hours]	1,2,7,9, 12,17,18, 19

Text Book

1. Seshu.P (2004), Finite Element Analysis, Prentice Hall of India.

Reference Books

1. Tirupathi R. Chandrupatla and Ashok D. Belugundu (2011), Introduction to Finite Elements in Engineering, 4th Edition, Prentice Hall.
2. David V Hutton (2009), Fundamentals of Finite Element Analysis, Tata McGraw-Hill Education.
3. Daryl L. Logan (2011), A First Course in the Finite Element Method, CengageLearning.
4. Reddy J.N (2005), Introduction to the Finite Element Method, III Edition, Tata McGraw Hill Edition.
5. Cook R.D (2007), Concepts and application of Finite Element Analysis, John Wiley and Sons.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Course Code : MEE3003	ENGINEERING FAILURE ANALYSIS	L	T	P	J	C
Pre-requisite : MEE2002		3	0	0	4	4

Module	Topics	L Hrs	SLO
1	**Introduction**: Material failure modes and their identification; Tools for failure analysis: Optical microscopy, Transmission electron microscopy, Scanning electron microscopy. Systematic approach to failure analysis.	6	1,4, 5
2	**Mechanical aspects:** Tensile test, Static loading, Combined stress, Principal stresses, Theories of failure, Triaxial stresses and constraint, Plane stress, Plane strain, Stress concentration factors and notch sensitivity. Shock and impact loading.	6	1,4, 5
3	**Fatigue**: Loading under high cycle fatigue conditions, Test methods, S-N-P curves, endurance diagrams, influence factors - Low cycle fatigue, fretting fatigue; Fatigue design for combined stress; cumulative damage and life prediction, statistical interpretation of fatigue test data.	10	1,4, 5, 6
4	**Analysis of Fatigue**: Failures related to corrosion, hot corrosion and stress corrosion cracking; Damages due to hydrogen; Creep of metallic materials, service failures during high temperature service; Failures related to wear.	6	1,4, 5, 6
5	**Other failure mechanisms:** Fracture processes, Meaning of ductile and brittle fracture, Effect of strain rate and temperature.	5	1,4, 5, 6
6	**Fracture processes:** Fracture mechanics and Failures, Linear elastic fracture mechanics, fracture mechanics principles in design practice, Elastic Plastic fracture mechanics, Examples of crack-growth Analysis for cyclic loading.	6	1,4, 5, 6
7	**Fracture mechanics and Failures**: Welded constructions and screw fastenings, Environmental degradation, Embrittlement of metals and alloys.	4	1,4, 5, 6
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**45**	
# Mode: Use of physical and computer models to lecture, Visit to Industry and study the actual failed components, Min of 2 lectures by industry experts			

Project

- Generally a team project [Maximum of 3 members only].
- Concepts studied should have been used.
- Down to earth application and innovative idea should have been attempted.
- Assessment on a continuous basis with a minimum of 3 reviews.

60 [Non-Contact Hours]

1,4,5, 6,11, 14, 17,18

Sample Projects:

Failure Analysis Project – Team or Individual. Topic of the project work may be choosen based on Failure analysis and investigation of engineering component like

1. Failure of a large air conditioner fan blade.
2. Cracked automobile suspension lower arm.
3. A cracked vaccum bellows.
4. Failed welded railroads rails.
5. Broken stainless steel hinge for a check valve., etc

It is essential to apply the knowledge gained in this course and incorporate them in the project. The project report should consist of Introduction, experimental and/or numerical investigation, results and discussion and conclusion. Final project report has to be

submitted at the end of the course. Guidelines for Project: • The project will be a group project with a maximum of 3 members in a group. The size will reflect the complexity of the project. Students should make sure that the concepts to be studied are reflected in the project. • There will be a minimum of three reviews conducted in a semester and the marks will be awarded and taken for final assessment. The marks distribution for 3 reviews will be 20:30:50. • Minimum pass marks for project is 50%. If the student fails to get 50%, he/she has to re-register and redo in a subsequent semester. • If the student has got >= 50% in project, and fails in Theory, then the same marks can be taken up for grading purposes after he/she completes the Theory FAT. Evaluation is through continuous assessment with 3 reviews. No separate FAT.		

Text Book

1. C. R. Brooks and A. Choudhury (2002), Failure Analysis of Engineering Materials, McGraw-Hill (ISBN: 0-07-135758-0).

Reference Books

1. McEvily (2001), Metal Failures, Wiley Interscience.
2. R.J. Shipley and W.T. Becker (2002),ASM Handbook -Failure Analysis and Prevention Vol. 11, © 2002, ISBN: 0-87170-704-7, ASM Publications.
3. A Venugopal Reddy (2004), Investigation of Aeronautical and Engineering Component Failures, CRC Press.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
Recommended by the Board of Studies on:	3.3.2016
Date of Approval by the Academic Council:	18.3.2016
Compiled by	Prof. M. Nageswara Rao Prof. K. Annamalai

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Course Code : MEE3004	INTERNAL COMBUSTION ENGINES					
Pre-requisite : MEE2003		L	T	P	J	C
		3	0	0	0	3

Module	Topics	L Hrs	SLO
1	**Mixture preparation in Spark Ignition Engines**: Spark ignition Engine mixture requirements - Feedback Control Carburetors – Properties of Fuel - Injection systems -Monopoint and Multipoint injection – Gasoline Direct Injection – Airmotion. **Mixture preparation in Compression Ignition Engines**: Direct and indirect injection systems – Combustion chambers - Properties of Fuel - Fuel spray behavior - spray structure - spray penetration and evaporation – Air motion- Injectors and nozzles.	11	1,2,4,5,11
2	**Combustion in Spark Ignition and Compression Ignition Engines:** Stages of combustion in SI and CI engines – Combustion phasing - heat release rate based on cylinder pressure measurement-Knock in CI and SI engines- Measurement and control of Knock.	5	1,2,4,5,11
3	**Power Boosting Systems:** Supercharging – Turbocharging - Variable area turbochargers, twin entry turbochargers - waste gate in turbocharger - different arrangements of turbochargers and super chargers - Effect on power and emission - basics of intake manifold tuning.	5	1,2,4,5,11
4	**Engine Emission and Control:** Pollutant - Sources and types – Effect on environment and human health - formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions - Catalytic converters and Particulate Traps - Selective Catalytic Reduction(SCR) - Diesel Oxidation Catalyst (DOC).	6	1,2,4,5,11
5	**Emission Measurement and Emission Norms:** Methods of measurements – Chemiluminescence - Non-Dispersive Infrared - Flame Ionisation Technique - Emission Norms and Driving cycles - Indian and Euro norms.	6	1,2,4,5,11
6	**Alternative Fuels:** Alcohol - Hydrogen - Natural Gas and Liquefied Petroleum Gas – Biodiesel- Biogas - Properties - Suitability - Engine Modifications - Merits and Demerits as fuels.	6	1,2,4,5,11
7	**Recent Trends in IC Engines:** LHR Engines - Learn Burn Engines - Stratified charge spark ignition engine – Homogeneous charge compression Ignition –Reactivity Controlled Compression Ignition- Rotary engine-Six stroke engine concept.	4	1,2,4,5,11
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**45**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts

Text Book

1. John Heywood (2011), Internal Combustion Engine Fundamentals, Tata McGraw Hill .
2. V Ganesan (2012), Internal Combustion Engine, 4th Edition, Tata Mc-Graw Hill.

Reference Books

1. Richard Stone (2012), Introduction to Internal Combustion Engines, 4th edition, Palgrave Macmillan.
2. Colin R. Ferguson, Allan Thomson Kirkpatrick (2001), Internal combustion engines: applied Thermosciences, John Wiley & Sons.

Mode of Evaluation	Digital Assignments /Seminars/Surprise Tests / CATs /FAT
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Course Code : MEE3005	REFRIGERATION AND AIR CONDITIONING	L	T	P	J	C
Pre-requisite : MEE2003		2	1	0	4	4

Module	Topics	L Hrs	SLO
1	**Refrigeration Cycle Analysis** – Development of Vapor Compression Refrigeration Cycle from Reverse Carnot Cycle – conditions for high COP – deviations from ideal vapor compression cycle – Multi-pressure Systems - Cascade Systems – Analysis.	3	1,2
2	**System Components** – Compressor - Types – performance – Characteristics of Reciprocating Compressors – Capacity Control – Types of Evaporators & Condensers and their functional aspects – Expansion Devices and their behavior with fluctuating load.	4	1,2
3	**Refrigerants** – Classification of Refrigerants – Refrigerant properties – Oil Compatibility – Environmental Impact- Montreal / Kyoto protocols – Eco Friendly Refrigerants. Different Types of Refrigeration Tools – Evacuation and Charging Unit – Recovery and Recycling Unit – Vacuum Pumps.	4	1,2
4	**System Balancing and Control** – Estimation of Cooling Load – System Equilibrium and Cycling Controls – Electric Circuits in – Refrigerators – Window A/C – Types of motors – Relays.	4	1,2
5	**Psychrometry** – Moist Air properties – use of Psychrometric Chart – Various Psychrometric processes – Air Washer – Adiabatic Saturation.	3	1,2,6,14
6	**Summer and Winter Air Conditioning**: Air conditioning processes – RSHF – summer Air conditioning – Winter Air conditioning – Bypass Factor. Applications with specified ventilation air quantity – Use of ERSHF – Application with low latent heat loads and high latent heat loads.	4	1,2,6,14
7	**Advanced Measurement Techniques and applications** – Shadowgraph – Schileren – interferometer – Laser Doppler anemometer – Hot wire anemometer – Heat flux sensors – Telemetry in measurement. Food processing and preservation – Freezing and drying – Cold storage – Refrigerated Containers and Trucks.	6	1,2,6,14
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
	# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.		
	Tutorial # A minimum of 5 problems to be worked out by students in every tutorial Class. # Another 5 problems per Tutorial Class to be given as home work. # At least one open ended design problem to be given. Tutorial class for Module 1 (2 hours) Tutorial class for Module 2 (23 hours) Tutorial class for Module 3 (2 hours) Tutorial class for Module 4 (2 hours) Tutorial class for Module 5 (2 hour) Tutorial class for Module 6 (2 hours) Tutorial class for Module 7 (2 hours) Tutorial class for Module 8 (1 hour)	**15**	1,2,6,14

Project # Group Project with a team of max. 5 members. ## Continuous Assessment will be done based on three reviews. **Sample Projects:** 1. Evaporator/condenser analysis of a R134a refrigeration system. 2. Boiling heat transfer studies of an R134a refrigerant. 3. Studies on heat transfer coefficient of refrigerants. 4. Double pipe heat exchangers for refrigeration systems. 5. Throttle valve analysis of a VCR system. 6. Pressure drop studies in a refrigeration system. 7. Influence of evaporator pressures on cycle efficiency of a refrigeration system. 8. Studies on sub-cooling and superheating of refrigerants. 9. Two phase flow studies in an evaporator core of a refrigeration system. 10. Tradeoff between single stage and two stage cascade refrigeration system. 11. R1234yf – Scope and challenges ahead. 12. Heat transfer studies on an air-washer used for air conditioning. 13. Cooling load estimation for theatres, shopping complex, high rise buildings etc. 14. Prototype designing and fabrication of components used in refrigeration and air conditioning. 15. Vortex tubes for cryo-cooling. 16. Methods to improve COP of refrigeration systems.	**60** [Non-contact Hours]	1,2,6,14

Text Book

1. W. F. Stocker and J. W. Jones (2002), Refrigeration and Air conditioning, McGraw Hill.

Reference Books

1. Manohar Prasad (2011), Refrigeration and Air conditioning, Wiley Eastern Ltd.
2. Arora, C. P. (2007), Refrigeration and Air Conditioning, Tata McGraw-Hill Publishing Company Ltd.

Mode of Evaluation	Digital Assignments / Surprise Tests / Seminars / CATs /FAT
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Compiled by	Prof. M. Boopathi Prof. C.P. Karthikeyan

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Course Code : MEE3006	AUTOMOBILE ENGINEERING	L	T	P	J	C
Pre-requisite : MEE2003		2	0	2	0	3

Module	Topics	L Hrs	SLO
1	**Vehicle Structure and Performance:** Automotive components, subsystems and their positions- Chassis, frame and body, front, rear and four wheel drives, Operation and performance, Traction force and traction resistance, Power required for automobile - Rolling, air and gradient resistance.	4	1,2
2	**Transmission Systems** – Clutch - Types- diaphragm type clutch, single and multi-plate clutches - Gear box: Types-constant mesh, sliding mesh and synchromesh gear box, layout of gear box, gear selector and shifting mechanism, overdrive, automatic transmission, Propeller shaft, universal joint, slip joint, differential and real axle arrangement, hydraulic coupling.	4	2
3	**Steering System** - Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages, power steering, wheel geometry-caster, camber toe-in, toe out etc., wheel Alignment and balancing.	4	1,2
4	**Suspension System** – Types - front and rear suspension, conventional and independent type suspension, leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems.	4	2
5	**Braking System** - Forces on vehicles, tyre grip, load transfer, braking distribution between axles, stopping distance, Types of brakes, Mechanical, Hydraulic, Air brakes, Disc & Drum brakes, Engine brakes anti-lock braking system.	4	1,2
6	**Automobile Electrical System and Instrumentation** - General electrical circuits. Battery, Starting motor, DC generator, Alternator, Ignition circuit, Dash board instrumentation, Lighting system.	4	1,2
7	**Advances in Automobile Engineering** - Passenger comfort - Safety and security - HVAC - Seat belts - Air bags - Automotive Electronics - Electronic Control Unit (ECU) - Variable Valve Timing (VVT) - Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program (ESP) Traction Control System (TCS) - Global Positioning System (GPS) - Xby- wire - Electric - Hybrid vehicle.	4	1,2
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts.			
Laboratory 1. Study of chassis and body (different types). 2. Assembling and disassembling of gear box (different types). 3. Study of transfer case, propeller shaft, slip joint and universal joint. 4. Assembling and disassembling of steering box (different types).		**30**	2

5. Assembling and disassembling of differential and rear axle. 6. Assembling and disassembling of clutch. 7. Determination of camber, caster, toe-in/toe-out. 8. Assembling and disassembling of components of hydraulic brake system. 9. Assembling and disassembling of components of air brake system. 10. Study on advanced technologies (ABS, EBD, VVT, Hybrid).		

Text Book

1. William. H. Crouse (2006), Automotive Mechanics, 10th Edition, McGraw-Hill.

Reference Books

1. David A. Corolla (2009), Automotive Engineering: Powertrain, Chassis System and Vehicle Body, Butterworth-Heinemann Publishing Ltd.
2. Richard Stone, Jeffrey K. Ball (2004), Automotive Engineering Fundamentals" SAE International
3. Bosch Automotive Hand Book (2007), 6th Edition, SAE Publications.
4. Kirpal Singh (2012), Automobile Engineering, Vol.1, Standard Publishers.
5. Kirpal Singh (2011), Automobile Engineering, Vol.2, Standard Publishers.
6. N. K. Giri (2008), Automobile Mechanics, 8th Edition, Khanna Publishers.

Mode of Evaluation	Digital Assignments / Surprise Tests / Seminars / CATs /FAT
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Course Code : MEE3008	MECHANICAL VIBRATIONS	L	T	P	J	C
Pre-requisite : MEE2004		2	1	2	0	4

Module	Topics	L Hrs	SLO
1	**Fundamentals of Vibration** - Harmonic motion- periodic motion- coordinates system- types of vibration- vibration terminology- Duhamel's integral - Impulse response function - Virtual work - Euler and Lagrange's equations.	3	1,2,4,6
2	**Single degree of freedom System** - Free and forced vibration with and without elastically coupled viscous dampers – System identification from frequency response - Transient vibration - Laplace transformation formulation.	3	1,2,4,6
3	**Two Degree of Freedom System** - Free vibration of spring- coupled system - Mass coupled system - Forced vibration - Vibration Absorber - Vibration isolation.	3	1,2,4,6
4	**Multi Degree of Freedom System** -Normal mode of vibration for free and forced vibration systems - Derivation of equation, calculation of natural frequencies by Rayleigh, Stodala, matrix, matrix iteration and Holzer methods.	4	1,2,4,6
5	**Properties of vibrating system** - Flexiblity matrix and stiffness matrix - Eigen value and Eigen vector – Orthogonal properties - Modal matrix - Modal analysis - Forced vibration by matrix inversion - Modal damping in forced vibration.	5	1,2,4,6
6	**Vibration of Continuous Systems** - Systems governed by wave equations - Vibration of strings - Vibration of rods - Euler's equation for beams - Effect of Rotary inertia and shear deformation.	5	1,2,4,6
7	**Experimental Methods in Vibration Analysis** -Vibration instruments - Vibration exciters Measuring Devices - Analysis - Vibration Tests -Free and Forced Vibration tests. Examples of vibration tests - Industrial case studies.	5	1,2,4,6
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	30	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts			
Tutorial Tutorial class for Module-1 (2 Hours) Tutorial class for Module-2 (3 Hours) Tutorial class for Module-3 (2 Hours) Tutorial class for Module-4 (2 Hours) Tutorial class for Module-5 (2 Hours) Tutorial class for Module-6 (2 Hours) Tutorial class for Module-7 (2 Hours)		15	1,2,4,6
Laboratory 1. Determination of the acceleration due to gravity using free vibration of different materials. 2. Estimation of spring stiffness and natural frequency of a spring -mass system using free vibration.		30	1,2,4,6, 14

3. Free Vibration analysis of Cantilever beam. 4. Forced vibration analysis of Cantilever beam subjected to harmonic excitation. 5. Determining damping ratio of a given viscous fluid. 6. Estimation of the moment of inertia of a disc using torsional vibration. 7. Estimation of natural frequency of a beam with negligible damping. 8. Calculation of the natural frequency of a Tapered beam. **9.** Modal analysis of simply supported structure using FE software and comparison with exact solution.		

Text Book

1. S.S. Rao (2011), Mechanical Vibrations, 5th Edition, Pearson Education.

Reference Books

1. Dukkipati RV (2012), Advanced Mechanical Vibrations, Narosa Publications.
2. Kelly SG (2013), Mechanical Vibrations, Mcgraw Hill(India) Ltd.
3. W.T. Thomson (2013), Theory of Vibration with Applications, 5th Edition, Prentice – Hall.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Compiled by	Prof. R. Manoharan Prof. Kannan

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Course Code: MEE3010	ROBOT DYNAMICS AND APPLICATIONS	L	T	P	J	C
Pre-requisite : MEE2004		3	0	0	0	3

Module	Topics	L Hrs	SLO
1	**Introduction to Robot manipulator -** Components of Industrial robot – Basic classifications – DOF of serial and parallel manipulator – Specifications of industrial robots – Singularity in robot work envelop – Dexterity – Introduction to redundant manipulator.	6	1,2
2	**Robot Kinamatics -** Representing Position and orientation – Homogeneous matrices - Forward kinematics – Inverse Kinematics – Denavit hartenberg representation for two link and three link planner.	6	1,5,7
3	**Velocity kinematics -** Velocity propagation – Velocity transformation – angular and linear velocity - Static force analysis – Derivation of Jacobian – inverse velocities and acceleration – wrist and arm singularity.	6	1,5,7
4	**Robot Dynamics -** Euler-Lagrange Equations – equation of motion – forward and inverse dynamics – properties of robot dynamics equations for two and three link planner.	6	1,5,7
5	**Trajectory planning -** Trajectory Vs path planning – Cartesian space and joint space interpolation – third and fifth polynomial equation for trajectory planning.	6	1,5,7
6	**Advance robot control -** Disturbance rejection – PID control – Computer torque control – Adaptive control – Feedback linearization for under actuated systems.	6	1,5,7
7	**Industrial application -** Welding – Assembly – Material handling – Loading and Unloading – Pressing – fettling – painting. **Social robots -** Mobile robot – types of wheeled mobile robot – Underwater robot – space robot - service robot – surgical robot.	7	1,2
8	**Contemporary Discussion**	2	2
	Total Lecture Hours		
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.		**45**	

Text Book

1. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar (2008), Robot Dynamics and Control, John Wiley & Sons.

Reference Books

1. S. R. Deb, SankhaDeb (2009), Robotics Technology And Flexible Automation, McGraw Hill Edition.
2. Fu, K.S., Gonzalez, R.C. and Lee, C.S.G. (2008), "Robotics: Sensing, Vision and Intelligence", Tata McGraw-Hill, New Delhi.
3. Craig, John. J. (2002), Introduction to Robotics: Mechanics and Control, Second Edition, Pearson Education, New Delhi
4. Niku, Saeed.B (2005), Introduction to Robotics: Analysis, Systems, Applications , Prentice Hall of India Pvt. Ltd , New Delhi.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT

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Compiled by	Prof. G. Kalaiarassan Prof. Arockia Selvakumar

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Course Code : MEE4001	TOOL DESIGN	L	T	P	J	C
Pre-requisite : MEE2006		3	0	0	4	4

Module	Topics	L Hrs	SLO
1	**Introduction to Tool Design** –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design- Tool drawings - Surface finish – Fits and Tolerances - Tooling Materials - Ferrous and Nonferrous Tooling Materials- Carbides, Ceramics and Diamond - Nonmetallic tool materials- Designing with relation to heat treatment.	7	5, 6, 7
2	**Design of Cutting Tools -** Metal cutting process - Selection of tool materials - Design of single point and multipoint cutting tool - Form tools, Drills, Milling cutters, broaches and chip breakers – Problems on design of single point cutting tools only.	6	1, 5, 9
3	**Locating and Clamping Methods -** Basic Principles of location - Locating methods and devices - Principles of clamping - Mechanical, Pneumatic and Hydraulic actuations - Clamping force analysis – Design problems.	6	5, 6, 8, 12
4	**Design of Jigs:** Types of drill jigs - General considerations in the design of drill jigs - Drill bushings - Types, methods of construction - Simple designs of Plate, Channel, Boxes, Post, Angle plate, Turnovers and Pot Jigs.	6	5, 6, 8
5	**Design of Fixtures -** principles - Types of fixtures - Fixtures for machine tools: Lathe, Milling, Boring, Broaching and grinding - Assembly fixtures - Inspection and Welding fixtures.	6	5, 6, 8
6	**Design of Press Tool Die -** Types of Dies – Method of Die operation– Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing.	6	1, 14
7	**Design of Forming Dies -** Bending dies– Forging dies – Extrusion dies - Drawing dies- Design and drafting	6	5,6
8	**Contemporary Discussion**	2	**2**
	Total Lecture Hours	**45**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts.			
Project • Generally a team project [Maximum of 3 members only]. • Concepts studied should have been used. • Down to earth application and innovative idea should have been attempted. • Assessment on a continuous basis with a minimum of 3 reviews. **Sample projects:** 1. To design a blanking punch and die for a given component. 2. To design a stripper and Die plate. 3. To design a forming die for sheet metal bending. 4. To design an angular milling fixture for machining a component. 5. To design a drill jig for a given component. 6. To design a cold drawing die for the given dimension of pipe. 7. To design the turning fixture.		**60** [Non-contact Hours]	2,3,4, 5,6,8, 11,17, 18

8. To design the milling fixture. 9. To design a Broaching fixture. 10. To design a friction welding fixture.		

Text Book

1. Donaldson C., Lecain G.H. and Goold V.C. (2012), Tool Design, 4th edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi.

Reference Books

1. E.G.Hoffman (2004), Jig and Fixture Design, Thomson Asia Pvt Ltd, Singapore.
2. Prakash Hiralal Joshi (2000), Tooling data, Wheeler Publishing.
3. Venkataraman K. (2005), Design of Jigs, Fixtures and Press tools, TMH.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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Compiled by	Prof. M. Anthony Xavior Prof. Jeyapandiarajan Prof. Christo Michael

VIT UNIVERSITY
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Course Code : MEE4002	ADVANCED MACHINING PROCESSES	L	T	P	J	C
Pre-requisite : MEE2006		2	0	0	4	3

Module	Topics	L Hrs	SLO
1	**Introduction to Advanced machining Processes**: Need and classification of non-traditional machining processes – Material removal in traditional and non-traditional machining process - considerations in process selection.	3	2,6
2	**Cold cutting process:** Abrasive Jet Machining (AJM), Water Jet Machining (WJM) and Abrasive Water Jet Machining (AWJM) - Basic principles, process variables, process Mechanism of metal removal, applications and limitations.	3	1,2,6,14
3	**Ultrasonic machining (UM):** Working principle, Mechanism of metal removal, Theory of Shaw, Elements of the processes, Tool feed mechanism, Effect of process parameters – Application, Limitation and case studies.	4	2,6,14
4	**High Energy Beam Machining:** Laser Beam Machining (LBM) – Electron Beam Machining (EBM) – Plasma Beam Machining (PBM) - Ion Beam Machining (IBM) – Mechanism of metal removal, Process characteristics, Accuracy and surface quality, Application.	4	2,5,6
5	**Electric Discharge Machining (EDM)** – Theory of EDM, Working principle, Pulse generator circuit – RC and Controlled pulse generator – Analysis of RC circuit - Selection of process parameters, tool electrode, dielectric fluid, Machining characteristics of spark eroded surface – Recent development in EDM process - Wire Electrical discharge machining (WEDM) – working principle, process variables, characteristics, applications.	4	1,2,6,14
6	**Chemical and Electro Chemical Machining Process:** Chemical machining - Fundamental principle, types of chemical machining, maskants, etchants - Electro Chemical Machining (ECM) – Theory of ECM – Working principle, Mechanism of metal removal, Tool design, Process characteristics – Advantages, limitations and applications.	3	1,2,6,14
7	**Hybrid Machining Process:** Electro Chemical Drilling – Shaped Tube Electrolytic Machining – Electrostream Drilling – Electro Chemical Jet Drilling – Electro Chemical Deburring - Electro Chemical Grinding (ECG) – Electro Chemical Honing (ECH) – Electrochemical super finishing – Electrical Discharge Grinding (EDG) – Electrical Discharge Diamond Grinding (EDDG) - Electro Chemical Discharge Grinding (ECDG) – Process capabilities and applications. **Advanced Finishing Process:** Abrasive Flow Machining (AFM) – Magnetic Abrasive Finishing (MAF) – Magnetorheological Finishing (MRH) - Chemo Mechanical Polishing (CMP) – Working principle – Mechanism of material removal – Surface quality – Applications.	7	1,2,6,14
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts .			
Project # Generally a team project of Five. # Concepts studied in Modules 2, 4, 6 should have been used.		**60** [Non-Contact	2,6,9,11, 16,17,18

# Down to earth application and innovative idea should have been attempted. # Report in Digital format with all drawings using software package to be submitted. # Assessment on a continuous basis with a min of 3 reviews.	hrs]	
Sample Projects: 1. To evaluate the machinability of difficult to machine materials and super alloys using any of the advanced machining processes. 2. To study the surface integrity of the electric discharge machined parts by analyzing the surface finish, surface and subsurface cracks, heat affected zone, etc. 3. To analyse the geometry of small holes drilled by spark erosion machining using coordinate measuring machine and video measurement system. 4. Development of new attachments for enhancing the utility of EDM and Wire EDM machines beyond their intended purpose. (e.g. orbital EDM, wire EDM turning, Electric discharge grinding, etc.) 5. Sustainable manufacturing practices in advanced machining (e.g. near dry/dry EDM). 6. Analyze the surface characteristics of Electro Chemical Machined component. 7. To evaluate the performance of new wire material in wire-EDM. **8.** Analyse the surface characteristics of components machined using advanced finishing process.		

Text Book

1. H. El-Hofy (2005), Advanced Machining Processes, McGraw-Hill, New York.

Reference Books

1. V. K. Jain (2002), Advanced Machining Processes, Allied publishers Pvt. Ltd.

Mode of Evaluation	Digital Assignments /Surprise Test /Seminars /CAT/FAT
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Compiled by	Prof. P. Kuppan Prof. Giridharan

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Course Code : MEE4003	MICRO AND NANO MACHINING	L	T	P	J	C
Pre-requisite : MEE2006		3	0	0	0	3

Module	Topics	L Hrs	SLO
1	**Introduction to Micro and Nano machining -** Classification and types of machining processes, Fundamentals of Micro and Nano machining processes, Nano materials and their applications in various industrial applications.	4	2
2	**Traditional Micro and Nano machining Processes -** Theory of micromachining, Operating principles and process parameters of Micro turning, Micro-milling, Micro-grinding, Applications and Limitations of micro machining.	6	17
3	**Advanced Mechanical Micro-Nano Machining processes –** Introduction - Classification of advanced Mechanical Micro - Nano Machining processes, Operating principles and process parameters of Abrasive Jet Micromachining (AJM), Water jet micro machining (WJM), Abrasive Water Jet Machining (AWJM),Ultrasonic Micromachining (USM), Abrasive Flow Nano finishing, Magnetic Abrasive Nano finishing.	6	2
4	**Advanced Thermo-electric Micro-Nano machining Processes** - Operating principles and process parameters of Electric Discharge Micromachining, Electric Discharge Grinding and Electric Discharge Diamond Grinding, Wire Electric Discharge Micromachining.	6	17
5	**High Energy Advanced Thermo-electric Micro-Nano machining Processes** - Operating principles and process parameters of Laser Beam Micromachining (LBM), Electron Beam Micromachining (EBM), Focused Ion Beam Machining (IBM)	5	2
6	**Advanced Electro-chemical Micro-Nano Machining Processes** - Operating principles and process parameters of Electrochemical Micromachining, Electrochemical Micro Grinding, Electro stream Micro drilling, Electrochemical Micro deburring.	6	2
7	**Modern Finishing Processes-** Advanced finishing processes (AFPs), abrasive flow machining (AFM), magnetic abrasive finishing (MAF), magnetorheological finishing (MRF), magnetorheological abrasive flow finishing (MRAFF), magnetic float polishing (MFP), elastic emission machining (EEM), ion beam machining (IBM), and chemical mechanical polishing (CMP). MEMS and Actuators - Sensors and Actuators, MEMs, Wet and Dry Etching-Surface Micromachining, Metrology For Micro manufactured Products.	10	17
8	**Contemporary Discussion**	2	2
	Total Lecture Hours		
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry and equipment, Min of 2 lectures by industry experts.		**45**	

Text Book

1. V. K. Jain (2007), Advanced Machining Processes, Allied Publishers Private Limited, New Delhi.

Reference Books

1. V. K. Jain (2014) "Introduction to Micromachining", Narosa, Publishers, New Delhi.

2. Mohamed Gad-el-Hak (2005) "MEMS Introduction and Fundamentals", CRC Press.
3. J. Paulo Davim, Mark J. Jackson (2008) "Nano and Micromachining", John Wiley & Sons.
4. Groover, M.P. (2007) "Fundamentals of modern manufacturing processes - Materials, Processes and Systems", 3rd Edition, John Wiley and Sons Inc.,
5. Abdel,H. and El –Hofy, G (2005) "Advanced Machining Processes", McGrawhill,USA.

Mode of Evaluation	Digital Assignments /Surprise Test /Seminars /CAT/FAT
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Course Code : MEE4005	SURFACE ENGINEERING	L	T	P	J	C
Pre-requisite : MEE2006		3	0	0	0	3

Module	Topics	L Hrs	SLO
1	Fundamental of surface engineering – Introduction - Surface dependent properties and failures of engineering components. Surface engineering – Scope, Classification, definition and general principles.	7	1, 2
2	Conventional surface engineering - Cleaning, pickling, etching, grinding, polishing and diffusion process - carburizing, nitriding - Electroless and Electroplating - Anodization and Electrophoretic deposition.	6	1, 2
3	Advanced Surface engineering practices - Thermal spray technologies – introduction - APS and HVOF - Effect of process parameters on coating properties - Cold spraying , warm spraying and Solution plasma spraying.	6	1,2
4	Laser surface modification - Laser hardening - Laser cladding - Laser texturing.	6	
5	PVD and CVD Technologies - Evaporation –thermal and Electron beam - PVD, RF- DC, EBM , CVD-HFCVD, PECVD and ion implantation.	6	2,5,6
6	Characterization of coatings and surfaces - Thickness and Roughness - Porosity and Adhesion - SEM and AFM - Raman and XPS - XRD – phases and stresses - Scratch and wear testing.	6	1,2
7	Nanocoatings – Importance and applications – Preparation of nano-coatings.	6	2,5,6
8	**Contemporary discussion**	2	2
	Total Lecture Hours	**45**	

 # Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry, Min of 2 lectures by industry experts.

Text Book

1. M.Ohring (2005), The Materials Science of Thin films, Academic Press Inc.

Reference Books

1. Kenneth Budinski (2009), Engineering Materials Properties and Selection, 9th Edition, Prentice Hall.
2. Peter Martin (2011), Introduction to Surface Engineering and Functionally Engineered Materials:, Interscience Wiley.
3. Steven Abbott and Nigel MacDermid (2013), Nanocoatings: Principles and Practice: From Research to Production, DEStech Publications.

Mode of Evaluation	Digital Assignments /Surprise Test /Seminars /CAT/FAT
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VIT UNIVERSITY
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Course Code : MEE4006	COMPUTATIONAL FLUID DYNAMICS	L	T	P	J	C
Pre-requisite : MEE1004, MEE2005		2	1	2	0	4

Module	Topics	L Hrs	SLO
1	**Introduction:** CFD overview - Applications of CFD.	1	2
2	**Governing Equations of Fluid Dynamics and Heat Transfer:** Models of Flow – Conservation and Non-conservation form - Continuity, Momentum and Energy Equation in conservation and non-conservation form (differential equations only) - Characteristics of PDE's - elliptic, parabolic and hyperbolic.	5	1,2
3	**Discretization:** Basic aspects of Discretization – Comparison of finite difference, finite volume and finite element techniques. **Finite Difference method:** Forward, Backward and Central difference schemes, Transient one and two dimensional conduction - Explicit, implicit and semi-implicit methods – Stability analysis and error estimation.	7	1,2,5,9
4	**Grid Generation:** Choice of grid, grid oriented velocity components, Cartesian velocity components, staggered and collocated arrangements.	5	1,2
5	**Convection and Diffusion:** Steady one-dimensional convection and diffusion - Central difference, upwind, quick, exponential, hybrid and power law schemes- False diffusion, SIMPLE – Algorithm.	4	1,2,5,9
6	**CFD Techniques :** ADI Technique - Pressure correction Technique – SIMPLE algorithm.	2	2
7	**Turbulence Modeling :** Introduction – Types of Turbulence modeling – Reynolds Time Averaging – Reynolds Time Averaged conservation equations – Boussinesq approach – One equation k - ε model.	4	2
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	
# Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical and computer models to lecture, Visit to Industry , Min of 2 lectures by industry experts.			
Tutorials Individual or group exercise Tutorial class for Module 3 (4 hours) Tutorial class for Module 5 (4 hours) Tutorial class for Module 6&7 (7 hours) (Case studies)		**15**	1,2,9
Laboratory 1. Modeling of simple and complex geometries. 2. Hexahedral meshing for simple geometries like square duct, circular pipe. 3. O-grid hexa meshing for circular pipe. 4. Tetrahedral meshing for simple geometries including fluid and solid domains. 5. Preprocessing in FLUENT – Case setup and analyzing for already mesh generated model.		**30**	17

6. Steady state temperature distribution in a rectangular plate (ANSYS Fluent and FDM). 7. Diffuser for a hydropower turbine. 8. Flow over an airfoil - Laminar and turbulent flow. 9. Supersonic flow past a wedge in a channel. 10. Exercise (for each student – different exercise) from FLUENT tutorial (case setup, analyzing, and post-processing).		

Text Book

1. John D Anderson (2012), Computational Fluid Dynamics – The Basics with Applications , McGraw Hill, New York.

Reference Books

1. Chung T.J (2014), Computational Fluid Dynamics , Cambridge University Press, London.
2. David C Wilcox (2006), Turbulence Modeling for CFD , DCW Industries, Inc.
3. Versteeg H.K and Malalasekara W (2008), An Introduction to Computational Fluid Dynamics - The Finite Volume Method , Longman.
4. Muralidhar K and Sundararajan T (2014), Computational Fluid Flow and Heat Transfer , Narosa Publications, New Delhi.

Mode of Evaluation	Digital Assignments / Surprise Tests / Seminars / CATs /FAT
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Course Code : MEE4007	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	J	C
Pre-requisite : MEE2004/ MEE3001		2	1	0	4	4

Module	Topics	L Hrs	SLO
1	**Flexible transmission elements:** Introduction to transmission systems – factors -materials selection –stresses – belt &chain drives, Design of flat and V- belts, Design of chain drives, Design of rope drives.	7	1,2,5, 6
2	**Design of bearings -** Lubrication, Design of journal bearings – using Sommerfeld number – using McKee's equations, Selection of rolling contact bearings – problems.	4	1,2,5, 9,11
3	**Design of spur gears -** Introduction **-** gear kinematics – forces & stresses – factors –materials selection – design of spur gears.	4	1,5,6, 9,17
4	**Design of helical gears-** Introduction **–** types **-** gear kinematics – virtual number of teeth - forces & stresses – factors – design of helical gears.	4	1,5,6, 9,17
5	**Design of bevel gears-** Introduction **–** classifications **-** gear kinematics – factors – design of bevel gears – force analysis.	3	1,5,6, 9,17
6	**Design of worm gears -** Introduction **–** classifications **–** applications – efficiency – design of worm gears.	3	1,5,6, 9,17
7	**Design of gear boxes-** Introduction – Types – Components – gear box housing – progression ratio – kinematic arrangement – ray diagram – design of multi speed gear boxes.	3	1,5, 9,11, 18
8	**Contemporary Discussion**	2	2
	Total Lecture Hours	**30**	

 # Mode: Individual Exercises and Team Exercises based on computer aided design of transmission systems, Online quizzes, Online discussion forums, Open ended assignments.
A minimum of 2 problems to be worked out by students in every tutorial class.
Another 2 problems per Tutorial Class to be given as home work.

Tutorial Tutorial class for Module 1 (2 hours) Tutorial class for Module 2 (2 hours) Tutorial class for Module 3 (2 hours) Tutorial class for Module 4 (2 hours) Tutorial class for Module 5 (2 hours) Tutorial class for Module 6 (2 hours) Tutorial class for Module 7 (3 hours)	**15**	1,5,6, 9,18
Project • Generally a team project [Maximum of 3 members only]. • Concepts studied should have been used. • Down to earth application and innovative idea should have been attempted. • Assessment on a continuous basis with a minimum of 3 reviews. **Sample projects**: 1. A full journal bearing has a journal with a diameter of 50 mm and a unilateral tolerance of -0.03 mm. The bushing bore has a diameter of 50.06 mm and a unilateral tolerance of 0.05 mm. The bushing is 25 mm long and support a load of	**60** [Non-Contact Hours]	2,6,7, 14,15, 17,20

2590 N at a speed of 800 rev/min. Find the minimum film thickness, the power loss and the total lubricant flow if the average film temperature is 54°C and SAE 20 lubricant is used. The tightest assembly is to be analysed. Show the pressure distribution by using the numerical simulation software (Like MATLAB, C language etc). 2. Design the spur pinion to transmit 15 kW at a speed of 600 rpm. The pinion is cut on the 20° full-depth system and has a module of 5 mm and 16 teeth. Find a suitable face width based on an allowable stress of 70 MPa. Ensure design safety by static and dynamic analysis with the help of simulation software (ANSYS, SolidWorks etc.). 3. Design the spur gear blank to transmit 20 kW at a speed of 400 rpm and has a module of 5 mm. compare the solid gear blank and rimmed gear blank strengths. Ensure design safety by static and dynamic analysis with the help of simulation software (ANSYS, SolidWorks etc.). 4. Design the spur gear blank to transmit 20 kW at a speed of 400 rpm and has a module of 5 mm. Compare the bolted gear blank and welded gear blank strengths. Ensure design safety by static and dynamic analysis with the help of simulation software (ANSYS, SolidWorks etc.). 5. Design the steel spur pinion and gear to transmit 25 kW at a speed of 1000 rpm and has a module of 5 mm. Ensure design safety by static and dynamic analysis with the help simulation software (ANSYS, SolidWorks etc.). 6. Design the steel spur pinion and gear to transmit 25 kW at a speed of 1000 rpm and has a module of 5 mm. Show the stresses developed by normal force in gear tooth and identify the highest stress locations. Identify the most suitable material for the gear drive. 7. In a turbine drive, 300 kW power is transmitted using a pair of double helical. gear. The pinion speed is 2950 rpm and that of the gear is about 816.5 rpm. There are no space constraints on the gear drive. Selecting suitable materials, design the pinion and the gear to last for 10^8 cycles. Design the gearbox completely. Also, ensure the design by using simulation software.		

Text Book

1. Joseph Edward Shigley and Charles, R. Mischke (2008), Mechanical Engineering Design, McGraw –Hill International Editions, 8th edition.

Reference Books

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger (2003), Design of Machine Elements, 8th Edition, Printice Hall.
2. Juvinal, R.C and Kurt M.Marshek. (2012), Machine component design, John Wiley.
3. V.B. Bhandari (2010) Design of Machine elements, Tata Mc Graw Hill, 3rd Edition.
4. Robert L. Norton (2013),Machine Design, Pearson Higher Education.
5. Robert C. Juvinall and Kurt M. Marshek (2005), Fundamentals of Machine Design, 4th Edition, Wiley.
6. B.J. Hamrock, and S.R. Schmid (2005), Fundamentals of Machine Elements, Tata McGraw Hill, New Delhi.
7. Design Data (2010), PSG College of Technology, DPV Printers, Coimbatore.

Mode of Evaluation	Digital Assignments /Surprise Test /CAT/FAT
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