DEPARTMENT OF MECHANICAL ENGINEERING

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

Scheme of Courses

B. Tech. (MECHANICAL ENGINEERING WITH SPECIALIZATION

IN   AUTOMOBILE ENGINEERING)

W.E.F. 2015-16 (2nd , 3rd, 4th year)

Delhi Technological University
(Formerly Delhi College of Engineering)
Shahbad Daulatpur, Bawana Road, Delhi–110 042

Vision

To be a world class university through education, innovation and research for the service of humanity.

Mission

1. To establish centres of excellence in emerging areas of science, engineering, technology, management and allied areas.

2. To foster an ecosystem for incubation, product development, transfer of technology and entrepreneurship.

3. To create environment of collaboration, experimentation, imagination and creativity.

4. To develop human potential with analytical abilities, ethics and integrity.

5. To provide environment friendly, reasonable and sustainable solutions for local & global needs.

DEPARTMENT OF MECHANICAL ENGINEERING

Vision

To become a global hub of academic excellence, research and innovation in the field of Mechanical, Production & Industrial, and Automobile Engineering.

Mission

To produce world class skilled Mechanical, Production & Industrial, and Automobile Engineers by imparting quality education through cutting edge technologies, and Research & Development enabling them to work towards sustainable professional development

Program Educational Objectives (PEOs)

PEO 1 : Graduate shall have ability to understand and apply core mechanical engineering knowledge to various automobile engineering problems.

PEO 2 : The graduates will be able to work in team, investigate the problem of automobile engineering and present an ecological sustainable solution.

PEO 3 : The graduates shall be competent in engineering modeling and experimental capabilities to pursue research and higher education in automobile engineering.

PEO 4 : The graduates shall have good communication skill, high ethical and social values.

DEPARTMENT OF MECHANICAL ENGINEERING
BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING WITH SPECIALIZATION IN AUTOMOBILE ENGINEERING)

I Year: Odd Semester

S. No.	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
								Group A						
1	MA101	Mathematics - I	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP101	Physics – I	ASC	4	3	0	2	3	0	15	15	30	40	-
3	AC101	Chemistry	ASC	4	3	0	2	3	0	15	15	30	40	-
4	ME101	Basic Mechanical Engineering	AEC	4	4	0	0	3	0	25	-	25	50	-
5	ME103	Workshop Practice	AEC	2	0	0	3	0	3	-	50	-	-	50
6	HU101	Communication Skills	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		**21**	**16**	**1**	**7**							
								Group B						
1	MA101	Mathematics - I	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP101	Physics – I	ASC	4	3	0	2	3	0	15	15	30	40	-
3	EE101	Basic Electrical Engineering	AEC	4	3	0	2	3	0	15	15	30	40	-
4	CO101	Programming Fundamentals	AEC	4	3	0	2	3	0	15	15	30	40	-
5	ME105	Engineering Graphics	AEC	2	0	0	3	0	3	-	50	-	-	50
6	EN101	Introduction to Environmental Science	AEC	3	3	0	0	3	0	25	-	25	50	-
		Total		**21**	**15**	**1**	**9**							

I Year: Even Semester

S. No.	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
		Teaching Scheme						Contact Hours/Week		Exam Duration (h)		Relative Weights (%)		
group A														
1	MA102	Mathematics - II	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP102	Physics – II	ASC	4	3	0	2	3	0	15	15	30	40	-
3	EE102	Basic Electrical Engineering	AEC	4	3	0	2	3	0	15	15	30	40	-
4	CO102	Programming Fundamentals	AEC	4	3	0	2	3	0	15	15	30	40	-
5	ME102	Engineering Graphics	AEC	2	0	0	3	0	3	-	50	-	-	50
6	EN102	Introduction to Environmental Science	AEC	3	3	0	0	3	0	25	-	25	50	-
		Total		**21**	**15**	**1**	**9**							
Group B														
1	MA102	Mathematics – II	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP102	Physics – II	ASC	4	3	0	2	3	0	15	15	30	40	-
3	AC102	Chemistry	ASC	4	3	0	2	3	0	15	15	30	40	-
4	ME104	Basic Mechanical Engineering	AEC	4	4	0	0	3	0	25	-	25	50	-
5	ME106	Workshop Practice	AEC	2	0	0	3	0	3	-	50	-	-	50
6	HU102	Communication Skills	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		**21**	**16**	**1**	**7**							

II Year: Odd Semester

S. No	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	PE261	Quantitative Techniques	AEC	4	3	1	0	3	0	25	-	25	50	-
2.	AE201	Engineering Mechanics	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	AE203	Thermodynamics	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	AE205	Manufacturing Machines	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	AE207	Engineering Analysis and Design	DCC	4	3	0	2	3	0	15	15	30	40	-
6.	MG201	Fundamentals of Management	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		**23**										

II Year: Even Semester

S. No	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	EE272	Automotive Electrical and Electronics	AEC	4	3	0	2	3	0	15	25	20	40	-
2.	AE202	Heat and Mass Transfer	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	AE204	Theory of Mach.	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	AE206	Mechanics of Solids	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	AE208	Material Engg. & Metallurgy	DCC	4	3	0	2	3	0	15	25	20	40	-
6.	HU202	Engineering Economics	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		**23**										

III Year: Odd Semester

S. No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	AE301	Manufacturing Technology	DCC	4	3	0	2	3	0	15	25	20	40	-
2.	AE303	Fluid Mechanics and Hydraulic Machines	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	AExxx	Departmental Elective Course -1	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30 /25	40 /50	-
4.	AExxx	Departmental Elective Course -2	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30 /25	40 /50	-
5.	UExxx	Open Elective Course	OEC	3	3	0	0	3	0	25	-	25	50	-
6.	HU301	Technical Communication	HMC	2	3	0	0	3	0	25	-	25	50	-
		Total		21										

III Year: Even Semester

S. No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	AE302	Design of Machine	DCC	4	3	0	2	3	0	15	25	20	40	-
2.	AE304	Internal Combustion Engines	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	AE306	Design of Automobile Components	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	AExxx	Departmental Elective Course -3	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30 /25	40 /50	-
5.	AExxx	Departmental Elective Course -4	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30 /25	40 /50	-
6.	HU304	Professional Ethics and Human Values	HMC	2	3	0	0	3	0	25	-	25	50	-
		Total		22										

IV Year: Odd Semester

S. No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	AE401	B.Tech. Project-I	DCC	4										
2.	AE403	Training Seminar	DCC	2										
3.	AE405	Alternative Fuels And Energy Systems	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	AE407	Production And Operations Management	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	AE409	Computer Aided Vehicle Design And Safety	DCC	4	3	0	2	3	0	15	25	20	40	-
6.	AE4xx	Departmental Elective Course -5	DEC4 /GEC	3	0/1	2/0	3	0	15	15/-	30 /25	40 /25	/50	
		Total		22										

IV Year Even Semester

S. No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	AE402	B.Tech Project-II	DCC	8										
2.	AE4xx	Departmental Elective Course -6	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30 /25	40 /50	
3.	AE4xx	Departmental Elective Course -7	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30 /25	40 /50	
4.	AE4xx	Departmental Elective Course -8	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30 /25	40 /50	
		Total		20										

LIST OF DEPARTMENTAL ELECTIVE COURSES

S. NO.	Elective Code	Title of Elective	Elective No.
1	AE-305	Automotive Aerodynamics & CFD	DEC-1, 2
2	AE-307	Combustion Generated Pollution	
3	AE-309	Operation Research	
4	AE-311	Tyre Technology	
5	AE-313	Thermal Engineering	
6	AE-315	Turbo machinery and gas dynamics	
7	AE-317	Power units and transmission	
8	AE-319	Computer Simulation of I.C. Engine Process	
9	AE-321	Advanced strength of material	
10	AE-323	Finite Element Methods and Applications	
11	AE-308	Measurement and Instrumentation	DEC-3,4
12	AE-310	Advanced Manufacturing Technology	
13	AE-312	Quality Management & Six Sigma Applications	
14	AE-314	Metrology	
15	AE-316	Advances in Welding & Casting	
16	AE-318	Materials for automobile components	
17	AE-320	Tribology and lubrication	
18	AE-322	Reliability & Maintenance Engineering	
19	AE-324	Elastic & Plastic Behaviour of Materials	
20	AE-326	Production Planning & Inventory Control	
21	AE-411	Vehicle Maintenance & Tribology	DEC-5
22	AE-413	Vehicle Transport Management	
23	AE-415	Power Plant Engineering	
24	AE-417	Robotics & Automation	
25	AE-419	Nuclear Energy	

26	AE-404	Computer Integrated Manufacturing Systems	DEC-6
27	AE-406	Total Life Cycle Management	DEC-7
28	AE-408	Refrigeration & Automobile Air Conditioning	and
29	AE-410	Fuel Cells	DEC-8
30	AE-412	Modern Vehicle Technology	
26	AE-414	Automobiles Vibration System Analysis	
27	AE-416	Renewable Sources of Energy	
28	AE-418	Supply Chain Management	
29	AE-420	Vehicle Safety Engineering	
30	AE-422	Packaging Technology	
31	AE-424	Mechatronics	
32	AE-426	Financial Management	
33	AE-428	Fracture mechanics	
34	AE-430	Product design and development	
35	AE-432	Tractors and Farm Equipment and Off Road Vehicles	
36	AE-434	Automobile process control	

LIST OF OPEN ELECTIVE COURSES

S.No.	SUBJECT CODE	SUBJECTS
1.	CO351	Enterprise & Java Programming
2.	CO353	E-commerce & ERP
3.	CO355	Cryptography & Information Security
4.	CO357	Operating System
5.	CO359	Intellectual Property Rights & Cyber Laws
6.	CO361	Database Management System
7.	EC351	Mechatronics
8.	EC353	Computer Vision
9.	EC355	Embedded System
10.	EC 357	Digital Image Processing

11.	EC359	VLSI Design
12.	EE351	Power Electronic Systems
13.	EE353	Electrical Machines and Power Systems
14.	EE355	Instrumentation Systems
15.	EE357	Utilization of Electrical Energy
16.	EE359	Non-conventional Energy Systems
17.	EE361	Embedded Systems
18.	EN351	Environmental Pollution & E- Waste Management
19.	EN353	Occupational Health & Safety Management
20.	EN355	GIS & Remote Sensing
21.	EP351	Physics of Engineering Materials
22.	EP353	Nuclear Security
23.	HU351	Econometrics
24.	MA351	History Culture & Excitement of Mathematics
25.	ME351	Power Plant Engineering
26.	ME353	Renewable Sources of Energy
27.	ME355	Combustion Generated Pollution
28.	ME357	Thermal System
29.	ME359	Refrigeration & Air Conditioning
30.	ME361	Industrial Engineering
31.	ME363	Product Design & Simulation
32.	ME365	Computational fluid dynamics
33.	ME367	Finite Element Methods
34.	ME369	Total Life Cycle Management
35.	ME371	Value Engineering
36.	MG351	Fundamentals of Financial Accounting and Analysis
37.	MG353	Fundamentals of Marketing
38.	MG355	Human Resource Management
39.	MG357	Knowledge and Technology Management

40.	PE351	Advance Machining Process
41.	PE 353	Supply Chain Management
42.	PE355	Work Study Design
43.	PE357	Product Design & Simulation
44.	PE359	Total Life Cycle Management
45.	PE361	Total Quality Management
46.	PT361	High Performance Polymers
47.	PT363	Separation Technology
48.	PT365	Non-Conventional Energy
49.	PT367	Polymer Waste Management
50.	PT369	Nanotechnology in Polymers
51.	PT371	Applications of Polymer Blends and Composite
52.	IT 351	Artificial Intelligence and Machine Learning
53.	IT 353	Data Structures and Algorithms
54.	IT 355	Communication and Computing Technology
55.	IT 357	Internet and Web Programming
56.	IT 359	Java Programming
57.	CE351	Geoinformatics and its Applications

1. Subject Code: **PE261**   Course Title: **Quantitative Techniques**
2. Contact Hours   :   L: 3   T: 1   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   4
6. Semester   :   III
7. Subject Area   :   AEC
8. Pre-requisite   :   NIL
9. Objective   :   Apply the most widely used quantitative techniques in decision making. Realize the Importance of certain mathematical techniques in getting the best possible solution to a problem involving limited resources.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction to statistics-Nature and role of statistics in management, Measures of central tendency, dispersion, Skewness and Kurtosis, Moments.	6
2	Introduction to probability theory- Probability theory, jointly distributed random variables, distributions - continuous and discrete; Sampling distributions.	4
3	Hypothesis Testing- Parameter estimation and hypothesis testing; Parametric tests; Z test, t-test, ANOVA; Non-parametric tests; Chi-square test, Correlation and regression analysis, Applications of statistical packages.	5
4	Linear Programming-Introduction to Linear programming, duality, sensitivity analysis, Introduction to non-linear programming.	9
5	Integer Programming- Introduction to Integer programming; pure integer case, mixed integer case, cutting plane method and branch and bound method.	10
6	Decision Theory-Decision Tree, Game Theory-Minimax and Maximin, Dominance Principle and use of OR software packages.	8
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1.	Operations Research by J K Sharma, MacMillan Publishers India Ltd., 5th ed., 2013, ISBN-978-9350-59336-3
2.	Quantitative Methods for Business by David R. elap. Anderson, Cengage Learning, 12th ed., ISBN 10: 840062338, 2013
3.	Business statistics by Naval Bajpai, Pearson Education India, 2009, ISBN: 978-81-317-2602-0, 1st ed.

1. Subject Code: **AE201**   Course Title: **Engineering Mechanics**
2. Contact Hours   :   L: 3   T: 0   P: 2

3.	Examination Duration (Hrs.)	:	Theory: 3 Practical: 0
4.	Relative Weight	**:**	CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5.	Credits	:	4
6.	Semester	:	III
7.	Subject Area	:	DCC
8.	Pre-requisite	:	NIL
9.	Objective	:	To give students practice in applying their knowledge of mathematics, science, and engineering in the vast area of "rigid body Mechanics" .

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Statics:** Introduction, Important Vector quantities of Mechanics, Equivalent System of Forces. Moment of a force: Varignon's Theorem. Couple, Equivalent Couples, Equilibrium of Rigid Bodies, Free Body Diagram, Conditions of Rigid Bodies. (Solution of the problems by Vector method also.)	6
2	Center of Gravity and Moment of Inertia: First and second moment of area and mass, radius of gyration, parallel axis theorem, product of inertia, rotation of axes and principal M. I., Thin plates,M.I. by direct method (integration), composite bodies. Virtual work and Energy method: Virtual Displacement, principle of virtual work, mechanical efficiency, work of a force/couple (springs etc.), Potential Energy and equilibrium, stability.	8
3	**Truss:** Types, Solution of Simple plane trusses by analytical and graphical methods.	4
4	**Friction:** Laws of dry friction, Friction Cone, Angle of Repose, Engineering Applications of friction e.g. Wedge, Belt & Pulley and Screw Jack etc. Shear Forces and Bending Moments in Different Beams. Dynamics	5
5	**Kinematics of Particles:** Rectilinear motion, plane curvilinear motion - rectangular coordinates, normal and tangential component. Kinetics of Particles: Equation of motion, rectilinear motion and curvilinear motion, work energy equation, conservation of energy, impulse and momentum conservation of momentum, impact of	9

	bodies, co-efficient of restitution, loss of energy during impact. Euler equations of motion and its application.	
6	**Kinematics of Rigid Bodies:** Concept of rigid body, type of rigid body motion, absolute motion, introduction to relative velocity, relative acceleration (Corioli's component excluded) and instantaneous center of velocity, Velocity and acceleration polygons for four bar mechanism and single slider mechanism. Kinetics of Rigid Bodies : Equation of motion, translatory motion and fixed axis rotation, application of work energy principles to rigid bodies conservation of energy.	10
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers TEXT BOOKS:
1.	Mechanics for Engineers: Statics and Dynamics, Beer and Johnston, TataMcGraw hill Publishing Company Limited.2013, ISBN-13: 978-0077295493
2.	Engineering Mechanics: I. H. Shames, Statics and dynamics, 4th Ed, PHI, 2002. ISBN-13: 978-0132791588
3.	Engineering Mechanics; -Bhavikatti, S.S; - New Age International Publishers, 2012, ISBN 13: 9780195696554
4.	Engineering Mechanics, J. L. Meriam and L. G. Kraige Vol I – Statics, Vol II – Dynamics, 6th Ed, John Wiley, 2012. ISBN 10: 0471841145

1. Subject Code: **AE203**   Course Title: **Thermodynamics**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   III

7. Subject Area   :   DCC

8. Pre-requisite   :   NIL

9. Objective   :   To introduce the student about basic concepts of thermodynamic laws ad processes for analysis of thermal systems and to enhance critical thinking and prepare him for facing thermal decision challenges.

10. Details of Course :

S. No.	Contents	Contact Hours
1	**Review of Basic Concepts and First Law of thermodynamics:** Concept of thermodynamic work and heat, equality of temperature, Zeroth law of thermodynamics. First Law of Thermodynamics, Energy and its Forms, Internal Energy and Enthalpy, P-V Plot for Different Processes, Steady Flow Energy Equation, 1st Law Applied to Non-Flow Process, Steady Flow Process and Transient Flow Process, Throttling Process and Free Expansion Process.	8
2	**Second Law of Thermodynamics and Availability:** Limitations of First Law, Thermal Reservoirs, Heat Engine, Kelvin- Planck and Clausius Statements and Their Equivalence, Carnot Cycle, Carnot Theorem and Its Corollaries, Entropy, Clausius Inequality, Principle of Entropy Increase, Entropy Change in Different Processes, Thermodynamic Relations. High and Low Grade Energy, Availability and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through A Finite Temperature Difference, Dead State of A System, Availability of A Non-Flow and Steady Flow System, Helmholtz and Gibb's Functions.	8
3	**Properties of Pure Substance:** Pure Substance and Its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling, Saturated and Superheat Steam, T-V, P-V and P-T Plots, Properties of Dry, Wet and Superheated Steam, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam.	6
4	**Steam boilers &Vapor power cycle:** Fire and water tube boiler, Boiler mountings and accessories. Rankine cycle and its analysis; effects of operating variable on the Rankine cycle, reheating, ideal and actual regenerative cycle and its limitations	6
5	**Fuels and Combustion:** Classification of Fuels- Solid, Liquid & Gaseous Fuels, Combustion Equations, Stochiometric Air-Fuel Ratio, Excess Air, Exhaust Gas Analysis, Orsat Apparatus. Enthalpy and Internal Energy of Combustion, Enthalpy of Formation, Adiabatic Flame Temperature, Calorific Values of Fuel. First & second law analysis of combustion systems	8

6	**Ideal and Real Gases:** Basic Gas Laws, Vander Waal's Equation of State, Reduced Co-Ordinates, Compressibility Factor and Law of Corresponding States. Mixture of Gases, Mass, Mole and Volume Fraction, Gibbs theorem, Dalton's Law	6
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Thermodynamics An Engineering Approach 7th Edition by Cengel and Boles Tata McgrawHill(2011), ISBN: 978007338174
2	Engineering Thermodynamics – P K Nag, Tata Mcgraw Hill, ISBN: 9781259062568
3	Fundamentals of Thermodynamics – E. Rathakrishnan, PHI, New Delhi, ISBN: 9788120327900
4.	Engineering Thermodynamics – Jones and Dugan, PHI, New Delhi. ISBN: 9780023613326
5.	Thermodynamics – C P Arora, Tata Mcgraw Hill ISBN: 9780074620144
6.	Thermal Science & Engineering- D.S.Kumar, SK Kataria&Sons, ISBN: 9789350134282

1. Subject Code: **AE205**   Course Title: **Manufacturing Machines**

2. Contact Hours   : L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0

4. Relative Weight   **:** CWS: 15   PRS: 25 MTE: 20   ETE: 40   PRE: 0

5. Credits   : 4

6. Semester   : III

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To introduce the student to different types of manufacturing machines and their mechanics of cutting, types of tools and machining processes.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Mechanics of orthogonal and oblique cutting-Mechanics of chip formation-Types of chips- Cutting forces and power-Temperature in cutting-Tool life –Tool wear- Cutting Tool Materials- -Cutting fluids.	6
2	Lathe: Types-Parts- Feed Mechanisms- Specifications of lathe-Lathe Operations- Accessories & Attachments - Capstan and Turret lathe-Lathe Tools - Cutting Speed- feed and machining time estimation.	8
3	Drilling: Operations – Types – Mechanisms - Nomenclature of twist drill – Tool and work holding devices - Machining time estimation. Shaper and Planer: Types – Specifications – Operations - Crank and slotted link mechanism - Stroke length adjustments - Automatic feed mechanisms – Hydraulic shaper - Tool and work holding devices - Machining time estimation – Shaper Tools - Difference in Shaper/ Slotter/Planer	8
4	Milling: Types - Up Milling Vs Down Milling - Types of milling cutters - Operations - Machining time, Estimation - Dividing head. Broaching: Types, - Operations - Broaching Tools.	8
5	Grinding: Specification and selection of grinding wheels - Truing, Dressing - Classification of Grinding wheels - Mounting of grinding wheels. Grinding machines Types: Cylindrical grinder, surface grinders and special grinding machines.	8
6	Finishing Processes: Lapping - Honing - Super-finishing processes. Modern Machining: High speed machining - Precision machining. Introduction to Unconventional machining methods.	6
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers TEXT BOOKS:
1	Geoffrey Boothroyd, Fundamentals of Metal Machining and Machine Tools, CRC press, ISBN-13:978-1574446593
2	Rao,P.N., Manufacturing Technology–Metal Cutting and Machine Tools, Tata McGraw Hill, New Delhi, ISBN-13: 9781259029561

3	Kalpakjian, S. and Steven R. Schmid, Manufacturing, Engineering & Technology, Prentice-Hall of India, ISBN-13-148965-8
4.	Raghuwanshi, B.S., Workshop Technology, Vol.II, Dhanpat Rai & Co. New Delhi, ISBN-13:1234567144378
5.	Lindberg R.A., "Process and Materials of Manufactures" Prentice-Hall of India, ISBN-13: 978-0205118175
6.	Brown J.A. "Modern manufacturing processes", Industrial Press Inc, ISBN-13:9780831130343
7.	Krar S.F., "Technology of machine tools" Mc Graw-Hill, New York. ISBN-13,9780028030715
8.	Paul E.D., Black J.T. and Kosher R.A, "Materials and Processes in Manufacturing", Wiley. ISBN-13:978047165653

1. Subject Code: **AE207**   Course Title: **Engineering Analysis and Design**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   **:**   CWS: 15 PRS: 25 MTE: 20   ETE: 40 PRE: 0

5. Credits   :   4

6. Semester   :   III

7. Subject Area   :   DCC

8. Pre-requisite   :   NIL

9. Objective   :   To Understand and discover processes and methods of creative problem solving. To Enhance and correlate their creative and innovative thinking skills. To Understand various aspects of IPR and patenting. To Analyze and apply various tools of creativity to some basic problems and Jugad innovations and To apply various ergonomics principles in newer innovations.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Specifications of Design, objectives and constraints.**Problem solving principles, Need for Creativity and Innovation, Creativity in Problem Solving, lifestyle- comfort and luxuryExamples and case studies Nature inspired innovationsDesign of various products inspired	10

	by nature like Green building, bullet train, Nike Clothing, Velcro, Adhesive Tape, self-heating plastic, friction reducing swimming suit, automated robot, screen display, deep blue case studies	6
2	Brain storming, Mind mapping, SWOC Analysis, Fishbone diagram, six thinking hats, Borrowing brilliance, Da Vinci's seven principles, Provocation and movement.	
3	**Drawing for Design**, Machine component & assembly drawings full and half section views, bill of materials.	4
4	**MEDICI EFFECT** Introduction, Intersection, Creating medici effect , Making intersectional ideashappen, Case studies **TRIZ INNOVATION** Introduction, Ideality, Resources, Contradictions, Pattern of innovation, Case studies **JUGAAD INNOVATION:** Jugaad tactics: Seek Opportunities in Adversity, Do more with less, Think and act Flexibly, Keep it simple, include the margin, Follow your heart. Case studies.	8
5	**Ergonomics** Concept; Man-machine-environment interaction system and user-friendly design practice; Human compatibility, comfort and adaptability; Fundamentals of ergonomics, environmental factors influencing human performance; Occupational stress; safety and health issues;Design process involving ergonomics check and ergonomic design evaluation and Participatory ergonomics aspects	6
6	**IPR and Patent**Introduction to IPR; Overview & Importance; IPR in India and IPR abroad;Patents ;their definition; granting; infringement ;searching & filing; Utility Models an introduction; Copyrights ; their definition; granting; infringement ;searching & filing, distinction between related and copy rights; Trademarks ,role in commerce, importance , protection, registration; domain names; Industrial Designs ; Design Patents; scope; protection; filing infringement; difference between Designs & Patents' Geographical indications legal issues, enforcement ;Case studies in IPR.	8
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers TEXT BOOKS:
1.	Daniel h. "pink a whole new mind" Publisher-Pearson publishing New Delhi (ISBN-13: 978-1594481710)

2.	Benyus, J. M. (1997). "Biomimicry: Innovation Inspired by Nature" Pubisher-Harper Perenial New York (ISBN 978-1-59017-133-2)
3.	Altshuller, G., and Shulyak, L ,Technical Innovation Center, "Keys to Technical Innovation" Inc, USA. (1997) '40 Principles: TRIZ. (ISBN: 978-0-387-75455-0)
4.	Edward De Bono, "Lateral thinking be more creative and productive",Publisher-penguin India (ISBN -10: 0141033088)
5.	Renault Nissan, Jugad innovation- (ISBN-13: 978-1118249741)
6.	Edward De Bono, "six thinking hats" (ISBN-13: 978-0141033051)
7.	Jonah Lehrer , "imagine, how creativity works",Publisher- Canongate, London (ISBN: 9781847677860)
8.	Steven Johnson, "Where Good Ideas Come From?"Publisher-Penguin Books (ISBN-10: 1594485380)
9.	Navi Radjou JaideepPrabhu and Simone Ahuja, Jugad innovation (ISBN-13: 978-1118249741)
10.	Malcolm GladwellBlink, "The Power of Thinking Without Thinking"Publisher- Little, Brown (ISBN-13: 978-0316010665), 2007
11.	Howard Gardner, "Five Minds for the Future" (ISBN-13: 978-1422145357)
12.	Daniel Goleman, "Emotional Intelligence" (ISBN 13: 9780553375060)

1. Subject Code: **MG201**   Course Title: **Fundamentals of Management**

2. Contact Hours   : L: 2   T: 0   P: 0

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight   **:** CWS: 25 PRS: 0 MTE: 25   ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : III

7. Subject Area   : HMC

8. Pre-requisite   : NIL

9. Objective   **:** The basic objective of this paper is to acquaint the students with the basic concepts of management necessary to deal with emerging business environment besides sensitizing them about societal challenges.

10. Details of Course:

S.No.	Detail Contents	Contact Hrs.
1.	Definition of management, importance of management, management principals, managerial roles, managerial ethos, management vs administration, managerial functions, task and responsibilities, organizational structure, motivation: meaning, theories and techniques.	8
2.	Concept of business environment, corporate social responsibility and corporate governance, managerial values and ethics.	8
3.	Objectives and importance of financial management, basics of capital budgeting, cost of capital, emerging sources of funds for new projects, introduction to stock market.	9
4.	Functions of marketing, marketing Vs sales, interface of marketing with other departments, customer life time value, new product development, unethical issues in marketing.	8
5.	Introduction to knowledge management, knowledge society, knowledge economy, building knowledge assets, sources of knowledge, technology innovation process, E-governance: definition, objectives and significance; challenges in Indian context, Digital India programme.	9
	Total	**42**

Suggested Books

S. No.	Name of Books / Authors/ Publishers
1.	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011(ISBN:9780273755869)
2.	Financial Accounting, 4 ed, S.N. Maheshwari and S.K. Maheshwari, Vikas Pulication,2005 (ISBN: 8125918523)
3.	Management, James A F Stonner, Pearson Education,2010 (ISBN: 9788131707043)
4.	Marketing Management, 14th ed., Philip Kotler , Kevin Lane Keller, Abraham Koshy and MithileswarJha, Pearson Education, 2013 (ISBN: 9788131767160)
5.	Knowledge Management in Organizations: A Critical Introduction, Donald Hislop, Oxford University Press,2013 ISBN: 9780199691937.

1. Subject Code: **EE272**   Course Title: **Automotive Electrical & Electronics**
2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15   PRS: 25   MTE: 20   ETE: 40
     PRE: 0
5. Credits : 4
6. Semester : IV
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : Students should be able to understand the needs and working principles of electrical and electronics component in the automobile like battery, charging system, stepper motors, microprocessor.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Automotive Electrical System: Classification of Automotive Electrical Systems – Generation, Storage, Distribution, Starting, Ignition, Lighting, Accessories – Electrical System – Earth & Insulated Return System – Positive & Negative Earthing. Automotive Electrical System & Batteries: Principles and Construction of Lead Acid Battery, Characteristics of Battery, Rating, Capacity and Efficiency of Batteries, Non-Over Filling Devices, Various Tests on Batteries, Internal Resistance of Battery, Maintenance and Charging, Charging Sulphated Batteries, Care of Batteries in Stock, Battery Failures, Long Life Battery, Alkaline Battery, Its Advantages Over Lead Acid, Nickel – Iron Battery, Nickel Cadmium Battery, Venner Silver – Zinc Battery, Fuel Cells, Trouble Shouting of Lead – Acid Battery.	8
2	Starting System & Charging System: Condition At Starting, Behaviour of Starter During Starting, Simple Motor, Torque Terms, Series Motor and Its Characteristics, Principle and Construction of Starter Motor, Working of Different Start Drive Units, Care and Maintenances of Starter Motor, Starter Switches, Trouble Shooting. Generation of Direct Current Simple, Generator, Type of D.C. Generators, Shunt Generator Characteristics, Commutation, Commutator Construction, Armature Reaction, Third Brush Regulation & Its Limitation, System of Connecting Fields, Cutout, Types of Voltage and Current Regulators, Compensated Voltage Regulator, Alternators Principle and	8

	Constructional Aspects and Bridge Rectifiers, New Developments, Trouble Shooting of Generator Alternator.	
3	Fundamentals of Automotive Electronic System: Current Trends in Automotive Electronic Engine Management System, Electro Magnetic Interference Suppression, Electromagnetic Compatibility, Electronic Dashboard Instruments, onboard Diagnostic System, Security and Warning System. Type of Sensors, Sensor for Speed, Throttle Position, Exhaust Oxygen Level, Manifold Pressure, Crankshaft Position, Coolant Temperature, Exhaust Temperature, Air Mass Flow for Engine Application, Solenoids, Stepper Motors, Relay. Programmable Logic Controls, Relay Logic Control, Motion Control. Ignition System: Composition of Ignition System, Types of Ignition Systems, Magneto Ignition, Magnetos – Ignition Coil and Its Construction, Mutual & Self Induction, Condenser, Distributor & Types – Spark Plug & Its Construction, Spark Plug Materials, Spark Plug Life, Special Plugs, Heat Ranges, Plug Fouling, Cam Angle & Contact Point Gap – Rotor Arm – Spark Plug Advance Mechanism – Centrifugal Advance – Inlet Manifold Vacuum Advance, Fully Vacuum Advance, Limitatio nof Coil Ignition System, Special Ignition System & Devices, Gas-Turbine Igniters, Ignition System Trouble Shooting.	6
4	Lighting System: Lights Sources, Energy Demand, HeadLights& Its Construction, Head Light Beam, Headlight Dazzle, Anti-Dazzle Devices, Bulbs & Wattages, Headlight Adjustments, Fog Lamps, Side & Tai Light, Brake Warning Lights, Led Lighting System, Horn, Wiper System, Trafficator, Electrical Switches, Indicating & Wiring Devices, Electrical Pumps, Heater & Defrosters, Latest Trends, Wiring & Installation, Auto Cables, Cable Colors, Cable Connectors, Wiring Harnesses, Circuit Breakers, Fuses, Printed Circuits, Plastic Fibreoptics, Trouble Shooting Telemetric – Bluetooth Technology for Communication, Consumer Electronics in Automobiles.	7
5.	Architecture : General 8 Bit Micropocessor and Its Architecture 8085, Z-80 and Mc 6800 Mpu and Its Pin Function Architecture - Function of Different Sections. Instruction Set : Instruction Format - Addressing Modes - Instruction Set of 8085 Mpu-T-State - Machine Cycle and Instruction Cycles - Timing Diagrams - Different Machine Cycles - Fetch and Execute Operations - Estimation of Execution Times.	6
6.	Assembly Language Planning : Construct of the Language Programming - Assembly Format of 8085 - Assembly Directive - Multiple Precision Addition and Subtraction – BCD to Binary	7

	and Binary to BCD, Multiplication, Division, Code Conversion Using Look Up Tables - Stack and Subroutines. Data Transfer Schemes : Interrupt Structure - Programmed I/O - Interrupt Driven I/O, Dma - Serial I/O. Interfacing Devices : Types of Interfacing Devices - Input / Output Ports 8212, 8255, 8251, 8279. Octal Latches and Tristate Buffers - A/D and/A Converters - Switches, Led's Rom and Ram Interfacing. Applications : Data Acquisitions - Temperature Control - Stepper Motor Control - Automotive Applications Engine Control Suspension System Control, Driver Information Systems), Development of A High Speed, High Precision Learning Control System for the Engine Control.	
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Ramesh, Goankar.S., " Microprocessor Architecture Programming and Applications " (ISBN-13-978-81-87972-88-4)
2	Young A.P. & Griffiths. L, " Automotive Electrical Equipment" ., Elbs& New Press – 1999. (ISBN-9780080969459)
3	William B. Riddens, "Understanding Automotive Electronics", 5th Edition – Butter Worth Heinemann Woburn, 1998 (ISBN-10-0750675993)
4.	Kohli P.L., "Automotive Electrical Equipment" Tata Mcgraw – Hill Co., Ltd., New Delhi, (ISBN-10-0070964679_
5.	Bechhold "Understanding Automotive Electronics" , SAE-, 1998. (ISBN-1-86058-073-1998)
6.	Crouse, "W.H Automobile Electrical Equipment"., Mcgraw – Hill Book Co., Inc., New York, 3rd Edition. (ISBN-13-9780070146655)
7.	Judge A.W, Chapman & Hall, "Modern Electrical Equipment of Automobiles" London, 1992. (ISBN-9789401168816)
8.	Robert Bosch, "Automotive Hand Book" , SAE- (5th Edition), 2000. (ISBN-9780837612430)
9.	Aditya.P.Mathur, " Introduction to Microprocessors ", III Edition, Tata Mcgraw-Hill Publishing Co Ltd., New Delhi, 1989. (ISBN-10-0074602225)
10.	Ahson.S.I. " Microprocessors With Applications in Process Control ", Tata Mcgraw-Hill, New Delhi, 1986. (ISBN-9780074515105)

11.	JabezDhinagar.S., " Microprocessor Application in Auto moblies ". (ISBN-9780080977683)

1. Subject Code: **AE202**   Course Title: **Heat and Mass Transfer**
2. Contact Hours   : L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0
4. Relative Weight   **:** CWS: 15   PRS: 25   MTE: 20   ETE: 40
   PRE: 0
5. Credits   : 4
6. Semester   : IV
7. Subject Area   : DCC
8. Pre-requisite   : NIL
9. Objective   : To familiarize the student basic concepts of modes of Heat transfer for analysis of thermal systems and to enhance critical thinking and prepare him for facing heat transfer design challenges.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction and Conduction:** Various modes of heat transfer, Fourier's, Newton's and Stefan Boltzman's Law, combined modes of heat transfer, thermal diffusivity, and overall heat transfer coefficient, thermal conductivity of solids, liquids and gases, factors influencing conductivity, measurement.General differential equation of conduction, one dimensional steady state conduction, linear heat flow through a plane and composite wall, tube and sphere, critical thickness of insulation, effect of variable thermal conductivity, conduction with heat sources, heat transfer from extended surfaces, fin performances, concept of corrected fin length/ error in temperature measurement by thermometer well.Transient heat conduction- lumped system analysis, transient temperature charts (Heisler and Grober charts), transient heat conduction in multidimensional systems.	10
2	**Convection (Forced):** Introduction, laminar boundary layer equations for internal and external flows; laminar forced convention on a flat plate and in a tube, Reynolds-Colburn analogy/Dimensional analysis and	10

	physical significance of the dimensionless parameters.**Convection (Natural):** Dimensional analysis of natural convection; empirical relationship for natural convection, convection with phase change, description of condensing flow, theoretical model of condensing flow, introduction to heat pipe, regimes of boiling heat transfer, empirical relationships for convection with phase change.	
3	**Thermal Radiation:** Introduction, absorption and reflection of radiant energy, emission, radiosity and irradiation, black and non black bodies, kirchchoff's law; intensity of radiation, radiation exchange between black surface, geometric configuration factor, grey body radiation exchange between surfaces of unit configuration factors, radiation shields, electrical analogy to simple problems, non-luminous gas radiation, errors in temperature measurement due to radiation.	8
4	**Heat Exchangers:** Different types of heat exchangers; design of heat exchangers, LMTD and NTU methods, fouling factor and correction factor, Introduction to compact and plate heat exchangers.	8
5	**Mass Transfer:** Mass and mole concentrations, molecular diffusion, Fick's law; eddy diffusion, molecular diffusion from an evaporating fluid surfaces, introduction to mass transfer in laminar and turbulent convection, dimensional less parameters in convective mass transfer, combined heat and mass transfer	6
Total		42

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1.	Fundamentals of Engineering Heat and Mass Transfer by R.C.Sachdeva, New Age International Publishers, 2010, USBN: 978-81-224-2785-1
2.	Fundamentals of Heat and Mass Transfer by P Frank. Incropera and David P. DeWitt, John Wiley and Sons
3.	Heat Transfer by A. Bejan, John Wiley and Sons, 1993, ISBN: 9780471502906
4.	Heat and Mass Transfer by D.S.Kumar, Katarya& sons Ltd., 2013, ISBN9789350142697
5.	Heat Transfer A Practical Approach by A.CenegelYunus, Tata McGraw Hill, ISBN: 9780072458930
6.	Heat and Mass Transferby J.P Holman, Tata McGraw Hill, ISBN: 0702296189

7.	Principles of Heat Transfer by Kreith and Bohn, Asian Books Private Ltd, 2010, ISBN: 9780495667704
8.	Fundamentals of Momentum, Heat and Mass Transfer by James R.Welty; John Wiley & Sons (Pvt). Ltd., 2007, ISBN: 9780470128688

1. Subject Code: **AE204**   Course Title: **Theory of Machines**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   **:** CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   IV
7. Subject Area   :   DCC
8. Pre-requisite   :   NIL
9. Objective   :   To familiarize the student with fundamentals of mechanisms, velocity and acceleration analysis, gears, types of balancing and mechanical vibration.
10. Details of Course:

S. No.	Contents	Contact Hours
1	Kinematic fundamentals, Mechanisms and machines, kinematics and kinetics. Degrees of freedom, types of motion, elements of kinematic chain, determination of degrees of freedom, paradoxes, isomers, linkage transformation, intermittent motion mechanism, inversion, grashof's criterion, straight line generating mechanisms.	8
2	Acceleration analysis: Graphical and vector solution: Position of any point on linkage, transmission angles, velocity by velocity polygon and instantaneous center method, acceleration, coriolis acceleration. Analytical solution for four-bar, slider-crank mechanism. Freudenstein's equation, velocity of slip. Computer aided analysis of position, velocity and acceleration.	8
3	Kinematic synthesis of mechanisms: Functioning and path generation, Chebyshev spacing of precision points, three position synthesis. Cam profile analysis: Motion of the follower, cam profile constructions, analysis of cams with specified contours.	6

4	Kinematic analysis of gears: Nomenclature and classification, law of gearing, path of contact, arc of contact, interference for spur gears. Gear trains: simple, compound, reverted, epicyclic gear trains, compound epicyclic, epicyclic with bevel gears, sun and planet gears.	6
5	Dynamic analysis and balancing: Slider-crank mechanism, turning moment computations and flywheel. Gyroscopes: Gyroscopic law, effect of gyroscopic couple on automobiles, ships and aircrafts. Balancing: Static and dynamic balancing, balancing of revolving and reciprocating masses, single and multi-cylinder engines, V-engines.	8
6.	Vibrations: Vibration analysis of SDOF systems, natural, damped, forced vibrations, transmissiblity ratio, vibration isolation and vibration of mass supported on foundations subject to vibrations, whirling of shafts.	6
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Thomas Bevan, "Theory of Machines", Pearson education ISBN:8131729656, 1944.
2	J.E. Shigley and J.J.Uicke, "Theory of Machines and Mechanisms", oxford university press india ISBN : 0195371232,2010
3	SS Rattan, "Theory of Machines", tata macgraw hill education ISBN : 007014477X, 2009
4	PR Balany, "Theory of Machines", tata macgraw hill publication ISBN : 817409122X, 2001

1. Subject Code: **AE206**   Course Title: **Mechanics of Solids**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   IV

7. Subject Area   :   DCC

8. Pre-requisite   :   NIL

9. Objective   :   To introduce the student with types of stresses at a point/ plane, bending and torsion analysis, types of cylinders, columns and types of springs.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	Stress and strain tensors: State of stress at a point, Principal stresses, Three stress invariants, Mohr's circle, Strain tensors, Constitutive laws, Theories of failure.	8
2	Strain Energy Methods: Strain energy in torsion and bending, Maxwell's reciprocal theorem, Castiglione's theorem, slope and deflection.	8
3	Bending &Torsion: bending of straight bars, T and I-sections. Torsion of thin-walled circular tubes.	6
4	Thin and thick cylinders under internal fluid pressure, wire winding of thin cylinders, stresses in shrink-fit and shaft. Rotating discs of uniform thickness.	6
5	Columns: Elastic instability, theory of long columns, end conditions, Rankine Gordon formula and other empirical relations.	8
6.	Springs: Helical, Spiral and leaf springs.	6
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	"Strength of Materials", Ryder G.H., Macmillan, Delhi, 2003.ISBN 0333935365
2	"Elements of Strength of Materials", Timoshenko S.P., East-West Affiliated, New Delhi,OCLC Number:808806720
3	Mechanics of materials by Beer and Johnston,DeWolfMazurek , 6th edition, 2013, ISBN-13: 978-1-25-909717-1
4.	Mechanics of materials by William F. Riley, Leroy D. Sturges and Don H. Morris; publisher: John Wiley and sons. ISBN : 978-0-471-70511-6,2007
5.	"Engg. Mechanics of Solids", Eger P. Popov, Prentice Hall, New Delhi, 2000, ISBN 81-203-0836-0
6.	Mechanics of Materials by James M.Gere. Thomson press, 5th Edition, 2004 , ISBN 981-254-863-7

1. Subject Code: **AE208**   Course Title: **Material Engineering & Metallurgy**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   IV
7. Subject Area   :   DCC
8. Pre-requisite   :   NIL
9. Objective   :   This course provides the knowledge on the structure, composition, and behaviour of material under various mechanical process. It also provides the knowledge on various metallurgical process. The study of this course will help the student to identify and select suitable material for various engineering application.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	Nature and properties of materials: Engineering materials: metal, ceramic, polymer, composites, Crystal structures, space lattices, miller indices, Defects: point defect, line defect, surface defect and bulk defect and theory of dislocation.	8
2	Structure determination using x-ray diffraction (Bragg's diffraction and structure factor for cubic lattices), Slip, twinning, effect of cold and hot working on mechanical properties, principles of recovery, re-crystallization and grain growth	8
3	Phase evolution: Definition of a phase, phase rule, solidification of metal and alloys, eutectic, eutectoid, peritectic, peritectoid reactions with examples, iron-carbon equilibrium diagram, TTT curve, heat treatment of plain carbon steels, annealing, normalizing, hardening, tempering, case-hardening-carburizing, cyaniding, nitriding, Induction Hardening, flame hardening, precipitation hardening of aluminum alloys.	6
4	Mechanical behavior: Concept of yield point and elastic modulus, fracture in ductile and brittle materials, Griffith's theory, Fracture toughness, ductile to brittle transition, fatigue and Design considerations. Creep, Mechanism of creep, creep curve, creep resistant materials, and effect of material variables on creep properties	6

5	Materials: plain clumin, die-casting and bearing alloys IS standards codes for steels.	
6.	Powder metallurgy: principles, techniques, application and advantages, surface treatment. Fiber Reinforced Composites: General characteristics, Applications, Introduction to Fibers – glass, carbon, Kevlar 49 fibers. Matrix – Polymeric, Metallic, Ceramic Matrix, Coupling agents and fillers.	6
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	William D. Callister. Material science and engineering : An introduction, John Wiley & sons ISBN: 13:978-0470556733
2	Raghvan V., Material science and engineering: A first course, sixth edition, PHI learning, ISBN: 978-81-203-5092-2
3	Kenneth G. Budinski, Engineering Materials: Properties and selection, ninth edition, ISBN: 13:978-0137128426
4.	George E Dieter, Mechanical Metallurgy, Mc Graw hill Education,1989, ISBN: 13:9780071004060

1. Subject Code: **HU202**   Course Title: **Engineering Economics**

2. Contact Hours   :   L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   **:**   CWS: 25 PRS: 0   MTE: 25   ETE: 50 PRE: 0

5. Credits   :   3

6. Semester   :   IV

7. Subject Area   :   DCC

8. Pre-requisite   :   NIL

9. Objective   :   To enable the students to understand the economic theories which may be applied to maximize return and economic environment in which they have to operate.

10. Details of Course   :

S.No.	Contents	Contact Hours
1.	**Introduction:** Nature and significance of economics, Goods and Utility, Basic Concept of Demand and Supply, Elasticity of Demand- Price elasticity of Demand, Cross elasticity of Demand, Production - Production Function, Production Process and Factors of Production, Market – Introduction to Monopoly, Perfect Competition, Oligopoly and Monopolistic Competition, Cost Concepts- Opportunity Cost, Total Cost, Average Cost; Marginal Cost; Life Cycle cost, Sunk Cost; Preparation of Cost Sheet Profit Maximisation- numerical problem.	10
2.	**Money- its evaluation and function, Bank- Commercial Bank and Central Bank and brief idea about function of banking system:** Tax and Subsidy, Type of Tax- Direct and Indirect, Monetary and fiscal policy, Inflation and Business cycle, International trade, terms of Trade, Gain from International Trade, Free Trade vs. Protection, Dumping, Balance of Payment.	10
3.	**Role of Science, Engineering and Technology in Economic Development:** Seven salient Feature of the Indian Economy; Inclusive Growth; relevance for the Indian Economy; Globalisation & opening up of the Indian Economy; GDP- definition and Its measurement; How knowledge of engineering and technology may be used to improve life at slum; Green Revolution and White revolution. Reasons for their success and can we replicate them. Appropriate Technology & Sustainable Development. Entrepreneurship: Macro environment for promotion of entrepreneurship: How environment has changed after advent of IT and Globalisation.	12
4.	**Elementary Economic Analysis:** Interest formulas and their Applications; Calculations of economic equivalence, Bases for Comparison of Alternatives: Present Worth Method, Future worth method, Annual equivalent, Internal Rate of Return; Business Risk; Factors which should be taken care while deciding price of the product in the market.	10
	TOTAL	**42**

11. **Suggested Books:**

S.No.	Name of Books / Authors/ Publishers
1.	G.J. Thuesen, & W.J. Fabrycky, Engineering Economy, Pearson Education, 2007, ISBN 013028128X

2.	William G. Sullivan, Elin M. Wicks, C. Patrick Koelling, Engineering Economy, Prentice Hall,(First Indian reprint). 2009, ISBN 0131486497
3.	Donald G. Newman, Jerome P. Lavelle & Ted G. Eschenbach, Engineering Economic Analysis, Oxford University Press, USA , 2004, ISBN 0195168070
4.	Seema Singh, Economics for Engineering Students, IK International Publishing House Pvt. Ltd, 2014, ISBN 8190777041

1. Subject Code: **AE301**   Course Title: **Manufacturing Technology**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   V
7. Subject Area   :   DCC
8. Pre-requisite   :   NIL
9. Objective   :   To introduce student with various types of conventional machines, unconventional machines, theory of metal cutting, design of tools and methods of measurement.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	Conventional Machining : General Principles (With Schematic Diagrams only) of Working, Types and Commonly Performed Operations in the Following Machines - Lathe, Shaper, Planer, Milling Machine, Drilling Machine, Grinding Machine, Gear Cutting - Basic of CNC Machine.	10
2	Unconventional Machining Processes : Need for Unconventional Machining Processes - Non conventional machining: Studies on basic principle, working and effects of process parameters of the following processes: Ultrasonic machining (USM), Abrasive jet machining (AJM), Electro-discharge machining (EDM), Electro-chemical machining (ECM), Electron beam machining (EBM), Plasma arc machining (PAM) and Laser beam machining (LBM). Ion Beam Machining (IBM), Biochemical Machining	8

3	Theory of Metal Cutting: Mechanics of metal cutting- Orthogonal and oblique cutting, Chip formation, Types of chips, Chip control, Merchants theory of cutting forces at tool point, Limitations and modifications of Merchants theory, Plowing forces and the 'Size effect', Heat generation in metal cutting, Cutting fluids and their physical action, Tool wear, Tool life and Machinability, Nomenclature of cutting tools and Cutting tool materials, Economics of machining, Analysis of milling and grinding processes.	8
4	Design Features of Machine Tools: Design requirements of machine tools, Kinematic drives of machine tools, Types of machine tool drives, Design of machine tool spindle. UNIT- V Jigs & Fixtures: Important considerations in jigs and fixture design. Main principles of designing of jigs & fixtures. Different devices and methods of locations. Different types of clamps used in jigs & fixtures.	8
5.	Metrology: Introduction to Metrology and its relevance, Linear and angular measurements.	8
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
	TEXT BOOKS:
1	HajraChoudury, "Elements of Workshop Technology", Vol. I andVol. II, Asia Publishing House, 1996. (ISBN-13-9788185099149)
2	B S Raghuwanshi, "Production Technology" Vol. 1,2 (ISBN-4567144376)
3	P N Rao "Manufacturing Technology",Vol.1, Tata Mcgraw Hill, 2003. (ISBN-9781259062575)
4.	Sharma P.C., "A Text Book of Production Engineering", Vol.1, S. Chand Publication,New Delhi, 2001. (ISBN- 9788121901116)
5.	Geoffrey Boothroyd, "Fundamentals of Machining & Machine Tools" Winston A. Knight, Marcel & Dekker Publications. (ISBN-10:1574446592)
6.	B.L.Juneja, G.S.Sekhon& Nitin Seth, "Fundamentals of Metal Cutting & Machine Tools", New Age International Publications (ISBN-8122414672)
7.	P.N.Rao, "Manufacturing Technology" Tata McGraw Hill Publications (ISBN-10:1259062570)
8.	Pandey & C.K. Singh, "Production Engineering Sciences" P.C. Standard Publications. (ISBN-9788186308950)

1. Subject Code: **AE303**   Course Title: **Fluid Mechanics and Hydraulic Machines**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   V
7. Subject Area   :   DCC
8. Pre-requisite   :   NIL
9. Objective   :   To provide an understanding of the fundamentals of fluid mechanics, and appreciation of the design principles in fluid systems, the ability to analyses existing fluid systems and capable to think new hydraulic system.
10. Details of Course:

S. No.	Contents	Contact Hours
1	**Basic Concept & Properties: Fluid** – Definition, Distinction Between Solid and Fluid – Units and Dimensions – Properties of Fluids – Density, Specific Weight, Specific Volume, Specific Gravity, Temperature, Viscosity, Compressibility, Vapour Pressure, Capillary and Surface Tension – Fluid Statics: Concept of Fluid Static Pressure, Absolute and Gauge Pressure Measurements by Manometers and Pressure Gauges.	8
2	**Fluid Kinematics and Fluid Dynamics:** Fluid Kinematics - Flow Visualization – Lines of Flow – Types of Flow –Velocity Field and Acceleration – Continuity Equation (one and Three Dimensional Differential Forms)- Equation of Streamline – Stream Function – Velocity Potential Function – Circulation – Flow Net.	8
3	**Fluid Dynamics: Equations of Motion**- Euler's Equation Along A Streamline – Bernoulli's Equation – Applications – Venturimeter, Orifice Meter, Other Flow Measurement Instruments, Pilot Tube. Dimensional Analysis Dimensional Numbers, Their Application. – Buckingham's ð Theorem – Applications – Similarity Laws and Models.	6
4	**Incompressible Fluid Flow: Viscous Flow –**Navier – Stoke's Equation (Statement only) – Shear Stress, Pressure Gradient Relationship Laminar Flow Between Parallel Plates – Laminar Flow	6

	Through Circular Tubes (Hagen Poiseulle's) – Hydraulic and Energy Gradient – Flow Through Pipes – Darcy – Weisback's Equation – Pipe Roughness –Friction Factor – Mody's Diagram – Minor Losses - Flow Through Pipes in Series and in Parallel – Power Transmission – Boundary Layer Flows, Boundary Layer Thickness, Boundary Layer Separation – Drag and Lift Coefficients.	
5.	**Hydraulic Turbines:** Impact of Jet on Flat, Curved & Moving Plates –Fluid Machines: Definition and Classification – Exchange of Energy – Euler's Equation for Turbo Machines – Construction of Velocity Vector Diagram's – Head and Specific Work – Component of Energy Transfer – Degree of Reaction.	8
6	**Hydraulic Pumps Compressor & Fans**: Pumps: Definition and Classifications – Centrifugal Pump: Classifications, Working Principles, Velocity Triangles, Specific Speed, Efficiency and Performance Curves – Reciprocating Pump: Classification, Working Principles, Indicator Diagram, Work Saved by Air Vessels and Performance Curves – Cavitations in Pumps Rotary Pumps: Working Principles of Gear and Vane Pumps. Definition – Classification Difference, Efficiency, and Performance Curves.	6
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
	TEXT BOOKS:
1	Hydraulic Machines- by K Subramanya , 2014, Mc Graw hill, ISBN-10: 1-25-900684-0
2	Fundamental of Fluid Mechanics by Munson, young, Okiishi, huebsch, 6th Edition, Wiley, 2013, ISBN 978-81-265-2392-4
3	Fluid Power with Applications by Anthony Esposito , 6th Edition, Pearson, ISBN 978-81-775-8580-3
4.	Hydraulic Machines including Fluidics by Dr. Jagdishlal, 6th Edition reprint 2010,metropolitan ,ISBN 81-200-0026-9
5.	Fluid Mechanics Cengel, Younus Tata Mc Graw Hill, III Edition , ISBN-10 : 0-07-070034-6, 2015

1. **Subject Code:** HU301   **Course Title:** Technical Communication
2. Contact Hours   :   L: 2   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   2
6. Semester   :   V
7. Subject Area   :   HMC
8. Pre-requisite   :   NIL
9. Objective   :   To train students for business communication to enhance employability skills with special emphasis on placement interviews and public speaking.

10. Details of Course   :

S. No.	Contents	Contact Hours
1.	**English for Professional Purposes:A.** Technical Communication- Methods, Strategies and Skills**B.** Communication in Global Contexts- Social, Cultural, Political and Technical, especially in formal set up	12
2.	**Communication at the Workplace: Oral and Written:A. Written Communication**- Letters, Orders (Sale/Purchase) Report Writing, Technical proposals Resume, SOP, Memo, Notice, Agenda, Minutes, Note Taking/Making, **B. Oral Communication**: Seminars, Conferences, Meetings, Office Etiquettes/ Netiquettes, Presenting Written Material Negotiation, Demonstration, Group Discussion, Interview	66
3.	**Group Discussion** and **Report Writing:A.** Group Discussion (Continous assessment through the semester)B. Minor Report Writing(to be submitted before Mid- Semester Examination)C.Major Report writing (To be submitted before End Semester Examination)	13
	Total	**28**

11. **Suggested Books:**

S.No.	Name of Books, Authors, Publishers
1	Technical Communication: Principles and Practice Raman, Meenakshi and Sangeeta Sharma, Oxford University Press, 2014, ISBN-13: 978-0-19-806529-6
2	Writing to Get Results, (3rd Ed) Blicq, Ron S., Lisa A. Moretto, John Wiley and Sons, Inc.,2001, ISBN 0-7803-6020-6
3	Effective Technical Communication: A Guide for Scientists and Engineers , Mitra, Barun K. OUP: Delhi, 2006, ISBN-13: 978-0-19-568291-5
4	Personality Development and Soft Skills, Mitra, Barun K. New Delhi: Oxford University Press.,2014, ISBN-9780198060017
5	The Essence of Effective Communication, Ludlow, Ron and Fergus Panton. Prentice Hall: PHI.,1996, ISBN-81-203-0909-X
6	Advanced Technical Communication, Gupta, Ruby. Foundation Books,2011, CUP. ISBN 978-81-7596-733-5
8	Soft Skills: Enhancing Employability, Rao, M.S. Connecting Campus with Corporate, 2011, ISBN: 978-93-80578-38-5
9	Developing Communication Skills (2nd Ed), Mohan, Krishna and Meera Banerji, Macmillan Publishers India Ltd.,2009 ISBN 13: 978=0230-63843-3

1. Subject Code: **AE302**   Course Title: **Design of Machine Elements**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   **:**   CWS: 15 PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VI

7. Subject Area   :   DCC

8. Pre-requisite   :   NIL

9. Objective   :   Student should be aware about the principle of design, aesthetics consideration in design. He should be able to understand the principle of welding, coupling drives and brakes

10. Details of Course   :

S. No.	Contents Contact Hours	
1	**Introduction:** : Principles of mechanical design, systematic design process, aesthetic and ergonomic considerations in design, use of standards in design. Manufacturing consideration in design, casting, machining, forging. Dynamic and fluctuating stresses, fatigue failure and endurance limit, stress concentration, causes and remedies in design, Factor of safety, Tolerances and types of fits. Selection of materials.	8
2	**Design of Elements:** : Cotter and knuckle joints; screwed fastenings, bolted and riveted joints under direct and eccentric loads.	8
3	**Welded Joints** : Welded joints, strength of welded joints, eccentrically loaded joints, welded joints subjected to bending moment and torsion.	8
4	**Shafts and Couplings** : Shafts, keys and couplings –design of rigid and pin bushed flexible couplings**Translation screws :** Force analysis and design of various types of power screws. Springs, uses and design of close coiled helical springs.	8
5	**Mechanical Drives:** : Selection of transmission, helical, bevel and worm gears, belt and chain drives.	6
6	**Friction Clutches & Brakes:** Common friction materials, shoe, band, cone and disc brakestheir characteristics and design, friction clutches.	4
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Maleeve Hartman and O.P.Grover,"Machine Design",Publisher- CBS Publication & Publishers(ISBN-8123906374)
2	V.B. Bhandari,"Machine Design", Publisher - Tata McGraw Hill(ISBN-9780070681798)
3	P.C. Sharma and D.K Aggarwal.,"Machine Design", Publisher-S.K. Kataria & Sons(ISBN-9350142813)
4	Mahadevan,"Design Data Book",Publisher-CBS Publishers & Distributors(ISBN-8123901623)
5	I.E. shigley & C.R. Mischke,"Mechanical Engineering Design",Publisher-Tata McGraw Hill Co.Inc.(ISBN-9780072832099)

1. Subject Code: **AE304**   Course Title:**Internal Combustion Engines**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3   Practical: 0

4. Relative Weight   :   CWS: 15 PRS: 25   MTE: 20   ETE: 40 PRE: 0

5. Credits   :   4

6. Semester   :   VI

7. Subject Area   :   DCC

8. Pre-requisite   :   NIL

9. Objective   :   To understand the basic principle and IC Engine. To know about different components in IC Engine. To know the basics of power generation in IC Engine. To analyse the combustion process in SI and CI engine. To understand and evaluate the auxiliary system in IC engine; such as supercharger/turbocharger. To apprise the theory of combustion and cause of emission and their control.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction to I.C Engines**:Principle of working, Classification; Air std. Fuel air and actual cycles, two and four stroke, SI and CI engines main parts, valve and port timing diagram	8
2	**Combustion Phenomenon in SI engines:**Principles of combustion in SI engine,effect of engines and operating variables on ignition delay & flame propagation, combustion chamber for SI engines, cycle to cycle variation, pre-ignition, abnormal combustion, theories of detonation, effect of engine and operating variables on detonation, surface ignition, adiabatic flame temperature, ignition systems	8
3	**Combustion phenomenon in CI engines:**Principles of combustion in CI engine, delay period, variables affecting delay period, diesel knock, methods of controlling diesel knock, combustion process & combustion chambers for CI engines	8
4	**Fuel system and Mixture requirement in SI and CI Engine:** Carburetion- working principles, chemically correct air-fuel ratio and load variation, compensating devices, venture and jet dimension calculation, modern fuel induction system, multi point fuel injection system, fuel injection: common rail direct injection	8

5	**Engine Testing, Supercharging, Lubrication and Engine Cooling:**Engine performance and testing , measurement of power, supercharging limits of SI &CI engines methods of supercharging, superchargers, turbo charging, lubrication principles, function of lubricating system, properties of lubricating oil, additives, cooling system, air cooling, water cooling	6
6	**Introduction to Automotive Fuels:**Petroleum based fuels and their properties, necessity of alternative fuels, LPG, CNG, producer gas, biogas, H2, biodiesel and alcohols, knock rating of engine fuels,	4
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Funguson, I.C Engines ISBN-13: 978-0471356172
2	Fundamentals of I.C Engines by HN Gupta. ISBN-13: 978-81-203-4680-2
3	Mathew & Sharma, I.C Engines by, Khanna Pub.ISBN, 9383182428.
4	Ganeson, IC Engines TMH, ISBN: 9781259006197

1. Subject Code: **AE306**   Course Title:**Design of Automobile components**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VII

7. Subject Area   :   DCC

8. Pre-requisite   :   NIL

9. Objective   :   To familiarize the students with the process of design and analysis of engineering systems and to enhance critical thinking and prepare him for facing design challenges. To familiarize him with statistical, decision making and optimization tools.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Design of friction clutches:** common friction materials, single plate, multi plate and centrifugal clutches and their characteristics and design of friction clutches	6
2	**Mechanical gears**: Design of Helical, Bevel and Worm Gears, Belt and Chain drives and Automotive Gear box assembly. UNIT III Brakes: Common friction materials, shoe, band, cone and disc brakes their characteristics and design of brake assembly	8
3	**Design of Bearings:** Rolling contact bearing: types of rolling contact bearings, static and dynamic load capacities, Stribeck's equation, equivalent bearing load, load life relationship, bearing life, load factor, selection of bearings from manufacturers catalogue. Lubrication and mountings, dismounting and preloading of bearings, oil seals and packing	8
4	**Sliding contact bearings**: bearing material and their properties, bearing types, and their constructional details, hydrodynamic lubrication- basic theory, design consideration in hydrodynamic bearings, Raimondi and Boyd method relating bearing variables	8
5	**Design of Engine Parts:** Piston, Engine Valves, Cylinder, Connecting Rod, Crank Shaft for CI and SI engines.	6
6	**Introduction to the design of automobile chassis**:Aerodynamic formulations, Calculation of various aerodynamic resistance	6
Total		**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
	TEXT BOOKS:
1	Maleeve Hartman and O.P. Grover, "Machine Design", CBS Publication & Publishers, ISBN-13: 978-8123906379
2	V.B Bhandari, "Machine Design", Tata Mcgraw Hill, ISBN 0070681791, 9780070681798
3	P.C. Sharma and D.K Aggarwal., "Machine Design", S.K. Kataria& Sons, ISBN 8185749094, 9788185749099

	REFERENCE BOOKS:
1	Mahadevan, "Design Data Book", CBS Publication & Publishers, ISBN-13: 978-8123923154
2	Daniel E Whitney, Mechanical Assemblies, Oxford Univ. Press, ISBN : 0195157826,2004

1. Subject Code: **HU302**   Course Title: **Professional Ethics and Human Values**
2. Contact Hours   :   L: 2   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   **:**   CWS: 25   PRS:0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   2
6. Semester   :   VI
7. Subject Area   :   HMC
8. Pre-requisite   :   NIL
9. Objective Processes   :   To make students aware of the ethics and codes of conduct required by Engineers and Professionals.
10. Details of the Course   :

S No.	Name of Books, Authors, Publishers	Contact Hours
1	**Human Values and Ethics:** Morals, Values, Ethics and Integrity, Need for Value Education for Engineers, Happiness, Prosperity, Harmony.	6
2	**Code of Ethics and Professionalism:** Professionalism and the Code of Ethics, Technical Education, Human Values and Coexistence, Universal Human Order, Natural acceptance.	6
3	**Professional Ethics and Technology :**Science, Technology and Professional EthicsEngineering Ethics, Environmental Ethics, Safety, Responsibility and Rights	8
4	**Case Studies:** Holistic Technologies, Eco-friendly production systems, The role of responsible engineers and technologists, Global Issues concerning Engineers	8
	Total	**28**

11. **Suggested Reference:**

S.No.	Name of Books, Authors, Publishers
1.	Professional Ethics, Subramanian, R, Oxford University Press, 2011 ISBN13: 978-0-19-808634-5
2.	Professional Ethics and Human Values,Govindarajan, M. S. Natarajan, V.S. Senthilkumar PHI, 2013**ISBN: 978-81-203-4816-5**
3.	Constitution of India and Professional Ethics, Reddy, G.B. and Mohd. Suhaib, IK International Publishing House. 2006 ISBN: 81-89866-01-X
4.	Introduction to Engineering Ethics (2nd Ed.) Martin, Mike W. and Roland Schingzinger McGraw-Hill, 2010 ISBN 978-0-07-248311-6

1. Subject Code: **AE401**   Course Title: **B.Tech Project-I**

2. Contact Hours   : L:0   T:0   P:0

3. Examination Duration (Hrs.) : Theory: 0 Practical: 0

4. Relative Weight   : CWS: 0 PRS: 0 MTE: 0 ETE: 0 PRE: 0

5. Credits   : 4

6. Semester   : VII

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students to work in group and develop an independent understanding of engineering and analysis of engineering systems. He should also be able to write and present the work done during the course.

1. Subject Code: **AE403**   Course Title: **Training Seminar**

2. Contact Hours   : L: 0   T:0   P:0

3. Examination Duration (Hrs.) : Theory: 0 Practical: 0

4. Relative Weight   **:** CWS: 0 PRS: 0 MTE: 0 ETE: 0 PRE: 0

5. Credits   : 2

6. Semester   : VII

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective : To familiarize the students to work in industry and working culture of the industrial system. He should also be able to write and present the work done during the course.

1. Subject Code: **AE405**		Course Title: **Alternative Fuels and Energy Systems**
2. Contact Hours	:	L: 3 T: 0 P: 2
3. Examination Duration (Hrs.)	:	Theory: 3 Practical: 0
4. Relative Weight	**:**	CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits	:	4
6. Semester	:	VII
7. Subject Area	:	DCC
8. Pre-requisite	:	NIL
9. Objective	:	To understand the need for the alternative fuels. To analyse the demand of energy for transportation and industry. To enable the students to analyse the requirement of fuels for use in IC engine. To estimate the demand and availability of alternative fuels. To compare the alternative fuel with present petro-fuels. To emphasise their advantages and limitations.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction :** Estimation of petroleum reserves - need for alternative fuels - availability and suitability to piston engines, Concept of conventional fuels, potential alternative fuels - ethanol, methanol, DEE/DME - hydrogen, LPG, Natural gas, producer gas, bio gas and vegetable oils - use in CI engines-merits and demerits of various fuels.	8
2	**Alcohol Fuels** : Properties as engine fuels - performance in SI engines - blends with gasoline and diesel - flexible fuel vehicle - Reformed alcohols - use in CI engines - emulsions	6
3	**Dual fuel systems** -spark assisted diesel engines –Surface ignition engines - ignition accelerators - combustion and emission characteristics in engines - emission characteristics.	6
4	**Gaseous Fuels :** Hydrogen - properties - use in CI engines - use in SI engines - storage methods - safety precautions. Producer	8

	Gas and biogas - raw materials - gasification - properties - cleaning up the gas - use in SI and CI engines, LPG & CNG - properties - use in SI and CI engines.	
5	**Vegetable Oils :** Conversion of vegetable oils as biodiesel –production techniques - standards and properties - performance and Emission characteristics, additives.	6
6	**Electric and solar powered vehicles :** Layout of an electric vehicle - advantage and limitations - specifications - system component. Electronic Control system - high energy and power density batteries - hybrid vehicle - solar powered vehicles.	8
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Osamu Hirao and Richard K. Pefley, Present and Future Automotive Fuels, John Wiley and Sons, 1988.ISBN: 047180259x
2	Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE- Publications, 1990, ISBN 978-0-7680-0052-8
3	Richard L.Bechtold, Automotive Fuels Guide Book, SAE- Publications, 1997
4.	Godfrey Boyle, "Renewable Energy", Oxford University Press, 2004, ISBN: 9780199545339

1. Subject Code: **AE407**   Course Title: **Production and operations management**
2. Contact Hours   : L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0
4. Relative Weight   **:** CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   : 4
6. Semester   : VI
7. Subject Area   : DCC
8. Pre-requisite   : NIL
9. Objective   : This course aims to introduce the students to operations strategy, product and process design; demand forecasting and inventory control methods.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Operations strategy and competitiveness :** Introduction to POM, Operations strategy, strategy design process, corporate and operations strategies, Operations competitive dimensions.	9
2	**Product and Process Design :** Product design and development processes, product life cycle, Process flow chart, Types of processes, Process performance, Learning curve.	9
3	**Facility location and Layout:** Factors affecting the location decisions, methods of facility location- factor rating systems, centroid method, and profit volume analysis; Types of layout, Block diagram and Assembly Line Balancing.	8
4	**Demand Forecasting :** Qualitative and quantitative forecasting, Time series and regression models, Measures of forecasting errors.	8
5	**Inventory model :** Importance of inventory, understocking and overstocking, Fixed order quantity models and fixed time period models (EOQ models), Selective inventory management- ABC, VED, and FSN analysis. Unit VI Lean Manufacturing : JIT manufacturing system, Toyota production systems- KANBAN model, and elimination of waste.	8
Total		**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
	TEXT BOOKS:
1	Jay Heizer, Barry Render, Operations Management,; Publisher-Pearson learning (ISBN 9780132658812)
2	Chase, Jacob, and Aquilano ,Operations management for competitive advantage;; Publisher-TMH(ISBN 9780072983937)
3	Buffa and Serin, Modern Production/Operations Management, Publisher- John Weily India (ISBN 8126513721)

1. Subject Code: **AE409**   Course Title : **Computer Aided Vehicle Design and Safety**

2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   VII
7. Subject Area   :   DCC
8. Pre-requisite   :   NIL
9. Objective   :   To enable the students to understand the basics of Vehicle design process, design parameters and some relevant software. To understand the need for vehicle safety and the basic components of vehicle safety. To be familiarize with the existing and latest safety systems.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction:** Study and Selection of a Vehicle; Specifications – Choice of Cycle, Fuel, Speed, Cylinder Arrangement, Number of Cylinders, Method of Cooling, Material, Design Variables and Operating Variables Affecting Performance and Emission of a vehicle. **Performance Curves:** vehicle Residence, Power and Torque Curve, Driving Force Against Vehicle Speed-Acceleration and Gradability in Different Gears for A Typical Car Or Truck Plotted From Specifications	6
2	**Vehicle Body Details:** Types: Saloon, Convertibles, Limousine, Estate Car, Racing and Sports Car. Visibility: Regulations, Driver's Visibility, Test for Visibility, Methods of Improving Visibility and Space in Cars. Safety Design, Safety Equipments for Cars. Car Body Construction; Design Criteria, Prototype Making,	8
3	**Vehicle Aerodynamics:** Objectives. Vehicle Drag and Types: Various Types of Forces and Moments, Effects of Forces and Moments, Side Wind Effects on Forces and Moments, Various Body Optimization Techniques for Minimum Drag, Wind Tunnel Testing: Flow Visualization Techniques, Scale Model Testing, Component Balance to Measure	8

	Forces and Moments. Gear Ratios Determination of Gear Ratios, Acceleration and Gradability	
4	**Engine Design:** Pressure Volume Diagram, Frictional Mean Effective Pressure, Engine Capacity, Calculation of Bore and Stroke Length, Velocity and Acceleration, Gas Force, Inertia and Resultant Force At Various Crank Angles – Side Thrust on Cylinder Walls.	8
5	**Indian and International Vehicle safety standards, requirement, various crash test methods,** Initial Tests, Crash Tests on Full Scale Model, Dummies and Instrumentation, **their computer aided simulations and applications.**	6
6	**Testing for Emissions: Various emission standards, standard test procedure, assessment of various emission control technologies, case studies**	6
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
	TEXT BOOKS:
1	Automobile Mechanics by Giri. N.K., Khanna Publishers – New Delhi – 2002, ISBN-13. 978-81-7409-216-1
2	High Speed Combustion Engine by Heldt. P.M., Oxford &Ibh Publishing Co., Calcutta 1989, ISBN-1-56091-563-3
3	Vehicle Body by J. Powloski, Business Books Ltd, London – 1989, ISBN 1356 - 1448
	REFERENCE BOOKS:
1	I C Engines by Lichty, Kogakusha Co., Ltd. Tokyo, 1991, ISBN-1-56091-563-3
2	Body Construction and Design by Giles. J.C., Liiffe Books Butterworth & Co, ISBN Number: 0-7680-0708-9
3	Vehicle Body Layout and Analysis by John Fenton– Mechanical Engg. Publication Ltd., London, ISBN, 0852984456
4	Vehicle Body Building and Drawing by Braithwaite.J.B.– Heinemann Educational Books Ltd., London, ISBN-13: 9781846289941

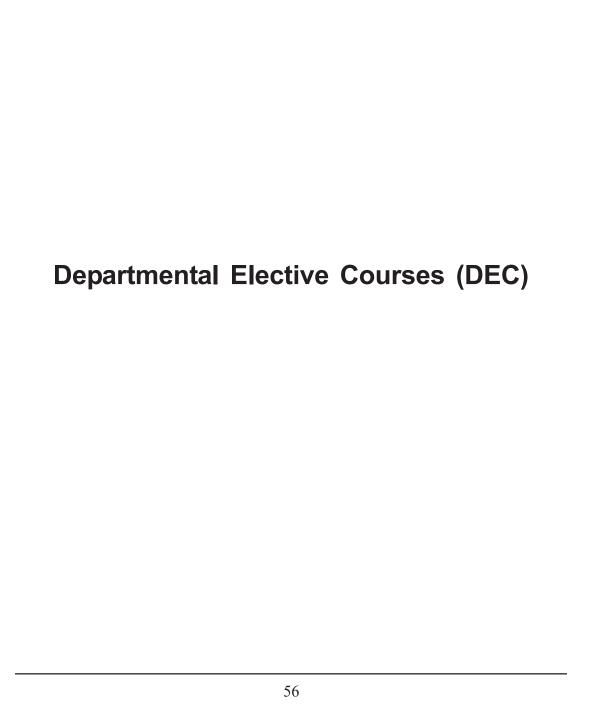1. Subject Code: **AE-402**   Course Title: **B.Tech project-II**
2. Contact Hours   :   L:0   T:0   P:0
3. Examination Duration (Hrs.)   : Theory : 0   Practical : 0
4. Relative Weight   **:** CWS: 0   PRS: 0   MTE: 0   ETE:0   PRE: 0
5. Credits   : 8
6. Semester   : VIII
7. Subject Area   : DCC
8. Pre-requisite   : NIL
9. Objective   : To familiarize the students to work in group and develop an independent understanding of engineering and analysis of engineering systems. He should also be able to write and present the work done during the course.

Departmental Elective Courses (DEC)

1. Subject Code: **AE305** Course Title : **Automotive Aerodynamics & CFD**
2. Contact Hours   : L: 3   T: 0   P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight   **:** CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   : 4
6. Semester   : V
7. Subject Area   : DEC
8. Pre-requisite   : NIL
9. Objective   : To introduce the student with aerodynamics, computational fluid dynamics, styling of vehicles, heat management of engines and wind tunnel testings.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Aerodynamics for Automobiles -** Fluid Properties, Fluid Statics, Measurement of Pressure, Fluid Kinematics, Fluid Dynamics, Euler and Bernoulli Equations, Ns Equations, Dimensional Analysis And Similitude, Viscous Flow, Flow Over Immersed Bodies, Boundary Layer, Production of Lift and Drag, Effect of Aerodynamic Forces on Stability of the Vehicle.	9
2	**Computational Fluid Dynamics -** Fundamentals of CFD Basics of Finite Difference and Finite Volume Methods, Boundary Conditions, Initial Conditions, Choice of Turbulence Models, Merits And Limitations of Commercial CFD Tools.	9
3	**Aerodynamic Styling of Vehicles -** Effect of Shape and Size of Various Exterior Parts of the Vehicle on the Drag Force, Details of Effect of Shape on Aerodynamics of Various Vehicles: Passenger Car, SUV, Utility Van, Mini Bus, Bus, Cargo, Truck and Towing Vehicle Aerodynamics of Race Cars- AE-Rodynamic Features of Race Cars, Measures to Create Negative Lift, Front and Rear Wings, Stability Consideration, Fluid Flow Over Brakes.	
4	**Thermal Management in Vehicles -** Engine Cooling Requirements, Underhood Cooling, Mechanism of Drag Production by the Cooling System.	8

5.	**Experimental Procedure and Facilities -** Basics of Wind Tunnels, Types of Wind Tunnels, Instrumentation for Wind Tunnels: Pressure Measurement, Velocity Measurement, Force and Moment Measurement Devices, Flow Visualization, Case Studies of Different Wind Tunnels Used for Vehicle Aerodynamics Experimentation.	8
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Bruce R. Munson, Donald F. Young, Theodore H. Okishi, Fundamentals of Fluid Mechanics, 4th Edition, John Wiley and Sons Inc, 2005, ISBN 0471675822
2	John F. Doughlas, Janusz M. Gasiorek, John A. Swaffield, , Fluid Mechanics, 5th Edition, Prentice Hall, 2006, ISBN 0131292935
3	Hucho W. H., Aerodynamics of Road Vehicles, 4th Edition, SAE- International, 2005, ISBN 0768000297
4.	Joseph Katz, Race Car Aerodynamics, Robert Bentley Publishers, Cambridge, 1995, ISBN 0837601428
5.	Barnard R.H., Road Vehicle Aerodynamic Design: An Introduction, Mechaero Publishing, March 2010, ISBN 0954073479
6.	Jewel B. Barlow, Willium H. RAE, Alan Pope, Low Speed Wind Tunnel Testing, 3rd Edition, Wiley Interscience, 1999, ISBN 0471557749
7.	Holman J.P., Heat Transfer, 8th Edition, Mc Graw Hill Company, Uk, 2001, ISBN 0072406550
8.	Steven Daly, Automotive Air-Conditioning and Climate Control Systems, Butterworth-Heinemann, May, 2006, ISBN 0750669551

1. Subject Code: **AE307**   Course Title: **Combustion Generated Pollution**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3   Practical: 0
4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   V
7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   To introduce the students with types fuels, emissions from various engines, exhaust treatment of various engines and instruments used for measuring emissions

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Combustion fundamentals:** Fuels, alternative fuels for IC engines, Type of hydro carbons. Gasoline specifications. Effect of Engine parameters on performance, fuel injection for SI engines, Engine vehicle road performance, road performance and fuel economy.	8
2	**Emissions and air pollution:** Automotive Emissions and their role in air pollution. Photo chemical smog. Chemistry of smog formation. Combustion in Homogeneous mixtures, emission formation. Incomplete combustion, formation of hydro carbons, Carbon monoxide and oxides of nitrogen. Aldehyde emissions.	8
3	**SI engine combustion Emissions:** Influence of design and operating variables on gasoline engine exhaust emissions. Hydrocarbon Evaporative Emissions: Various sources and methods of their control. Canisters for controlling evaporative emissions. Emission control systems for gasoline engines: Blow by control closed PCV system design**.**	6
4	**CI engine combustion Emissions: Sources of emissions during combustion.** Effect of air fuel ratio, speed, injection timing on performance and emission formation. D.I and I.D.I engine emissions,smoke emission from diesel engines	6
5.	**Exhaust treatment devices**: Air injection into exhaust system, Thermal reactors, Catalytic convertor**. Stratified charge engines. Honda CVCC engine. Methods of reducing emissions exhaust gas recirculation.**	8
6.	**Emission Instruments**: Non- dispersive Infrared analyzer, Gaschromotograph, flame ionization detector, Chemiluminescent analyzer	6
Total		**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	B.P. Pundir, Engine emission :, Narose Publication ISBN-13: 978-8184870879
2	Paul Degoberd, SAE Automobile and air pollution, SAE Publication ISBN 978-. 07680-6437-7
3	J.P. Heywood, Fundamentals of I.C. Engines,Tata McGraw Hill Publication. ISBN 13: 9780071004992

1. Subject Code: **AE309**   Course Title: **Operation Research**
2. Contact Hours   : L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0
4. Relative Weight   **:** CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   : 4
6. Semester   : V
7. Subject Area   : DEC
8. Pre-requisite   : NIL
9. Objective   : This course aims to introduce students to use mathematical approach for effective decision making, model formulation and applications that are used in solving business decision problems. After study, the students will be able to solve the real life problems and obtaining the right solution requires understanding and modelling the problem carefully and applying appropriate optimization tool and skills to solve the mathematical models.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction :**Nature, Scope and Historical developments, Linear programming- Model formulation, Graphical and simplex methods, Duality, Degeneracy, sensitivity analysis.	8
2	**Transportation :**North-West corner rule, Least cost method, VAM, Methods to check the optimality, Assignment- Hungarian method and Sequencing models: Johnson Rule for n- job two- machine, n- job m- machine.	8

3	**Queuing theory :**Assumptions and applications of waiting line theory, M/M/1: /FCFS, M/M/K: /FCFS, M/M/K	6
4	**Game theory and its applications** : Pure and mixed strategy, dominance principle, Algebraic, arithmetic, and graphical methods to solve GT problems.	6
5.	**Replacement models:** Replacement policy for the items that deteriorate over time, replacement policy for the items that deteriorate over time when time value of money is declining, replacement policy for the items that fails suddenly.	8
6.	**Network Planning :** PERT, CPM, Project crashing, Shortestpath problem, Maximum flow problem, Minimum **spanning tree problem, minimum cost flow problem, Resource levelling.**	6
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1.	Operations Research: Theory and Applications by J K Sharma, Macmillan, ISBN: 9780230638853
2.	OperationsResearch: An introduction by H A Taha, Pearson Education, ISBN: 978-0132555937
3.	Operations Research: Concepts and cases by F S Hiller and G J Liebermaan, TMH, ISBN:0073523453
4.	Quantitative Technique in Management by N D Vohra, TMH, ISBN: 9780070611931

1. Subject Code: **AE311**   Course Title: **Tyre Technology**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   V

7. Subject Area   :   DEC

8. Prerequisite   :   NIL

9. Objective   : This course aims to introduce the students with types of tyres used for different vhicles, design of tyres, manufacturing of tyres and testing of tyres.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction :** Importance of tyres, history, current status, functions of pneumatic tyres, applications, types of tyres, desirable tyre properties, classification of tyres based on carcass, tyre profile, geometry, sizing & designation, tyre components, principle of pneumatic tyre, requirements of pnumetictyres.	8
2	**TyreDesign :** General, motion forces, heat build up, types of bonding, set of service conditions, tyre size requirements, safety requirements: Tread design, general, role of foot print area and factors affecting tread life, various types of tread pattern. Carcass design, role of foot print area and factors affecting tread life, various types of tread pattern. Carcass design, role of various fibers used in carcass, estimation of number of piles, Bead design, single bead, multiple beads, and various configurations of wires in bead assembly.	8
3	**Compound Design :** General introduction, role of various mixing ingredients, various recipes.	8
4	**Manufacture Technology :** Compound mixing, mixing equipments, extrusion of components, tyre cord, wire cord manfacture, calendaring tyre manufacture, mold procurement, component preparation, green tyre building, pre curing, curing and post curing operations/treatments.	8
5.	**Tyre testing/ Evalution Methods :** General safety standards, carcass strength, resistance to bead unseating, machine simulation test, indoor laboratory testing, field-test on roa, proving ground, lates testing techniques.	8
Total		**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Tyre Technology, S.N. Chakravarty, Indian Rubber Institute

2	Roop S. Bhakuni, Surendra K. Chawla, D. K. Kim,D. Shuttleworth,Tires Cord, Encyclopedia of Chemical Technology, Kirk &Othmer, John Wiley & Sons, 2000
3	E.C. Wood, Pneumatic Tyre Design, W. Heffer, 1952
4.	Tire Engineering, Kovac& Rodgers, Goodyear Tire Rubber Co., Ohio 3. Handbook of Rubber Technology, R. Schuster, Wiley Interscience

1. Subject Code: **AE313**   Course Title: **Thermal Engineering**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   V
7. Subject Area   :   DEC
8. Pre-requisite   :   NIL
9. Objective   :   This course introduces students with types of boilers, steam nozzles, types of steam turbines, steam condensers and centrifugal compressors.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction to Boilers :** Classification of boilers, boiler mountings and accessories; draft systems, circulation system; combustion and its calculations, and boiler performance.	6
2	**Steam Nozzles :** Types of nozzles, flow of steam through nozzles; condition for maximum discharge through nozzle; nozzle efficiency, effect of friction and supersaturated flow through nozzle.	8
3	**Steam Turbines :** Working principle and types of steam turbines; velocity diagrams for impulse and reaction turbines, compounding of impulse turbines; optimum velocity ratio and maximum efficiency, blade twisting, comparison of impulse and reaction turbines,condition line and reheat-factor, losses in steam turbines; governing of steam turbines.	8

4	**Steam Condensers:** Types and working of condensers, types and performance of cooling towers.	6
5.	**Reciprocating Air Compressor :** Steady flow analysis, isothermal, adiabatic and polytropic compression; single and multi-stage compression, ideal intermediate pressure; compressor clearance, volumetric and isothermal efficiency; minimum work requirement of a compressor.	8
6.	**Centrifugal compressor :** Velocity diagrams, efficiency of compressor stage, choice of reaction, stage pressure rise, surging, multi-stage compressor, compressor performance, vaccum pump.	6
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1.	P.K. Nag,"Engineering Thermodynamics",Publisher-Tata Mcgraw Hill Publishing Company Limited(ISBN-1259062562)
2.	Gordon Rogers,"Engineering Thermodynamics",Publisher-Pearson Education(ISBN-8131702065)
3.	Kenneth Wark,"Thermodynamics",Publisher-Mcgraw-hill Book Company(ISBN-0070682844)
4.	Gordon Rogers and Yon Mayhew, "Engineering Thermodynamics", Publisher-Pearson publisher(ISBN-9788131702062)
5.	Van Wylen and Sonntag, "Fundamentals of Classical Thermodynamics", Publisher-John Wiley & Sons Inc.(ISBN-0471041882)
6.	Moran and Shaprio, "Fundamentals of Engineering Thermodynamics , "Publisher-John Wiley & Sons, Inc.(ISBN-9780470032091)
7.	Cengel and Boles,"Thermodynamics: An Engineering Approach, "Publisher-The McGraw-Hill Companies(ISBN-9789814595292)
8.	T.D. Eastop,"Applied Thermodynamics for Engineering Technologists" ,Publisher-Longman publisher(ISBN-9788177582383)
9.	S. Domkundwar,"Thermal Engineering",Publisher-DhanpatRai& Co (p) Ltd 9(ISBN-8177000217)
10.	Onkar singh,"Applied Thermodynamics",Publisher- New Age International (p) Limited (ISBN-8122425836)

1. Subject Code: **AE315**   Course Title: **Turbo machinery and gas dynamics**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VI

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   This course aims to introduce the student with principles of Turbomachinery, types of turbo devices such as turbines, fans and blowers. This course also offers about the gas dynamics and jet propulsion in engines.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	Turbomachinery Principles, Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.	8
2	**Centrifugal Fans And Blowers :** Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, Characteristics curves and selection, fan drives and fan noise.	8
3	**Centrifugal And Axial Flow Compressors :** Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves. Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple Stage design problems and performance characteristics.	6
4	**Axial And Radial Flow Turbines :**Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and Performance characteristics.	6
5	**Gas Dynamics:-** Continuity Equation, Momentum Equation, Energy Equation, Stagnation Properties; Isentropic Flow With Variable Area, Wave Motion; Flow With Normal Shock Waves, Oblique Shock Waves, Flow in Constant Area Duct With Friction and	8

	With Heat Transfer, Measurement of Fluid Properties, Anemometer, Flow Visualization.	
6	**Jet Propulsion:-** Aircraft Propulsion Theory, Ramjet Engine, Pulsejet Engine; Rocket Propulsion, Liquid Propellant, Solid Propellant, Rocket Propulsion Theory, Rocket Applications, Space Flights.	6
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	S.M. Yahya, " Fundamentals of Compressible Flow ", John Wiley and Sons Ltd, 1994, ISBN8122403727
2	P.Hill and C. Peterson, " Mechanics and Thermodynamics of Propulsion ", Pearson Education,2009 ISBN0132465485
3	N.J. Zucrow, " Aircraft and Missile Propulsion, Vol. I & II ", John Wiley , 1958, ISBN 1258694360
4	N.J. Zucrow, " Principles of Jet Propulsion and Gas Turbines ", John Wiley, New York, 1957,
5	H.Cohen, G.E.C.Rogers and Saravanamuttoo, " Gas Turbine Theory ", Longman Group Ltd., 1996, ISBN 0582236320
6	A.H.Shapiro, " Dynamics and Thermodynamics of Compressible Fluid Flow Vol. I ", John Wiley , 1953, ISBN 0471066915
7	V.Ganesan, " Gas Turbines ", Tata Mcgraw Hill Publishing Co., New Delhi, 2010, ISBN 0070681929,
8	G.P.Sutton, " Rocket Propulsion Elements ", John Wiley, 2010, New York, ISBN 0470080248

1. Subject Code: **AE-317**   Course Title:**Power units and transmission**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VI

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   To understand the requirement of Automotive Power Plant. To know the power characteristics of IC engine and other Automotive Power Plants. To analyze the means of power transmission from engine to driving wheels. To know the working of the electrical/hybrid system power transmission.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Transmission:** Introduction, requirements of automobile propulsion and transmission system, Discussion on tractive effort and other performance parameters.	8
2	**Clutch:** Need of clutch, types of clutches, construction of clutch systems and clutch plates, operation and torque transmission characteristics. CVT, diaphragm and centrifugal clutch and fluid flywheel.	8
3	**Gear box:** Requirements of gearbox, different types of gear boxes vizsliding ,constant mesh and Synchromesh, construction details of gear boxes.	6
4	**Hydro-dynamic drive:** Fluid coupling, principle and operation torque capacity performance characteristic, torque converter construction, principle of operation, torque capacity, multistage torque converter performance.	6
5	**Automatic transmission:** Construction and operating principle, three forward and reverse, four forward and reverse. Over drive unit need and its operation. Hydrostatic drive: construction and operation. Electric drive Ward Leonard control system, construction and operation, advantages and disadvantages.	8
6	**Drive line and Differential:** Need and construction of drive line components, universal joints. Need and requirement of differential, principle of operation and construction. Limitations of ordinary differential and concept of limited slip differential.	6
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Crouse W and Anglin D, Automotive Mechanics, Tata Mcgraw Hill Publication ltd 10thedition 2004 ISBN Number: 0-7680-0708-9
2	Nakra C P, Basic Automobile, Dhanpat Rai Publication Co. Ltd 7th Edition2005 ISBN, 978-93-5216-040-2
3	JosepeHeitner Automotive Mechanics – Principle and Practice, East West Press 2nd edition 1999. ISBN:9788176710152 8176710156
4	Motor Vehicle by Newton, Gerreand Steeds, BH publications.ISBN 9780195699630
5	P S Gill, Automobile Engineering, Unit - I, II, III, SK Kataria& Sons, ISBN 978-81-89757-22-9

1. Subject Code:**AE319**   Course Title:**Computer Simulation of I.C. Engine Process**

2. Contact Hours   : L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0
4. Relative Weight   **:** CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   : 4
6. Semester   : VI
7. Subject Area   : DEC
8. Pre-requisite   : NIL
9. Objective   : To know the basic combustion in IC engine .to learn some relevant simulation softwares. To analyse combustion for the performance parameters. To analyse the combustion for emission .to understand the impact of combustion chamber geometry and other related parameters on combustion in IC engine.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction :** Introduction - Heat of Reaction - Measurement of URP- Measurement of HRP - Adiabatic Flame Temperature: Complete Combustion in C/H/O/N Systems, **Constant Volume**	11

	Adiabatic Combustion, Constant Pressure Adiabatic Combustion. Calculation of Adiabatic Flame Temperature - Isentropic Changes of State.	
2	**Engine Simulation With Air As Working Medium :** Deviation Between Actual and Ideal Cycle - Problems, SI Engine Simulation With Adiabatic Combustion, Temperature Drop Due to Fuel Vaporisation, Full Throttle Operation - Efficiency Calculation, Part Throttle Operation, Super Charged Operation.	10
3	**Engine Simulation Fuel Air and actual cycles:** Deviation Between Actual and Ideal Cycle - Problems, SI Engine Simulation With Adiabatic Combustion, Temperature Drop Due to Fuel Vaporisation, Full Throttle Operation - Efficiency Calculation, Part-Throttle Operation, Super Charged Operation.	11
4	**Progressive Combustion :** SI Engines Simulation With Progressive Combustion With Gas Exchange Process, Heat Transfer Process, Friction Calculation, Compression of Simulated Values, Validation of the Computer Code, Engine Performance Simulation, Pressure Crank Angle Diagram and another Engine Performance. Simulation of 2-Stroke SI Engines.	10
5	**CI Engine Simulation:** Mixing of Air & Fuel, Multi Zone Model for Combustion, Different Heat Transfer Models, Equilibrium Calculations, Simulation of Engine Performance, Simulation for Pollution Estimation.	
6	**SI Engine Simulation:** Multi Zone Model for Combustion, Different Heat Transfer Models, Stoichiometric Calculations, Simulation of Engine Performance, Simulation for Pollution Estimation.	
Total		**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Ganesan.V. "Computer Simulation of Spark Ignition Engine Process ", Universities Press (I) Ltd, Hyderabad, 1996. ISBN 9780195699630
2	Ramoss.A.L., " Modelling of Internal Combustion Engines Processes ", Mcgraw Hill Publishing Co., 1992 ISBN 0-76-80-0052-1

3	A shleyCampbel, " Thermodynamic Analysis of Combustion Engines ", John Wiley & Sons, New York, 1986. ISBN-13: 9780898747744
4	Benson.R.S., Whitehouse.N.D., " Internal Combustion Engines ", Pergamon Press, Oxford, 1979 ISBN 13: 9780080227207

1. Subject Code: **AE321**　　　　　　　Course Title:**Advanced strength of material**
2. Contact Hours　　　　　　　:　L: 3　　　T: 0　　P: 2
3. Examination Duration (Hrs.)　:　Theory: 3 Practical: 0
4. Relative Weight　　　　　　**:**　CWS: 15　　PRS: 25　　MTE: 20　　　ETE: 40　PRE: 0
5. Credits　　　　　　　　　　:　4
6. Semester　　　　　　　　　:　VI
7. Subject Area　　　　　　　:　DEC
8. Pre-requisite　　　　　　　:　NIL
9. Objective　　　　　　　　　:　this course introduces the students with theory of elasticity, torsion of non-circular sections, deformation and design of members for fatigue and creep.
10. Details of Course　　　　　:

S. No.	Contents	Contact Hours
1	**Theory of Elasticity:** Plane stress and plane strain problem, strain-displacement relation, stress - strain relations, equilibrium equations, body force, compatibility equations, airy stress function, analysis of simple two dimensional problems in Cartesian coordinates.	9
2	**Plates:** Bending of circular plates carrying uniformly distributed load over entire surface or with concentrated load at centre, simply supported rectangular plate carrying uniformly distributed (excluding derivation of formulae).	9
3	**Torsion of non-circular section shafts:** St. Venant's methods, torsion of shafts of elliptical and rectangular sections, membrance analogy, torsion of shafts of thin tubular section. Laterally loaded columns: Analysis of long columns carrying lateral loads in addition to axial compression eccentrically loaded columns. Beams on Elastic Foundations: Modules of foundation, equat- ion of elastic curve, solution for beams of infinite and semi inf- inite length.	8

4	**Deformation beyond elastic limit:** Behaviour of material beyond elastic limit, perfectly plastic material, torsion of shafts and analysis of thick cylinders with radial pressure when loaded beyond elastic limit, residual stresses. Mechanics of forming processes: Mechanics of wire drawing and tube drawing through cylindrical and conical dies, calculation of draw forces, effect of back pull, mechanics of forging process.	8
5	**Miscellaneous Topics:** Contact stress in ball and roller bearings, bending of curved tubes, stress analysis of flywheel. Design of members for fatigue and creep: Fatigue behaviour, factors affecting fatigue, mechanics of fatigue failure, fatigue under combined stresses, fatigue life and cumulative fatigue, design formulae for fatigue calculations. Mechanics of creep, relationships regarding creepratesat different stresses and temperature, bending of beams at high temperature, stress relaxation in steam turbine bolting, creep under combined stresses, creep analysis of rotating discs.	8
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	E.J. Hearn,"Mechanics of Materials: v. 2: An Introduction to the Mechanics of Elastic and Plastic Deformation of Solids and Structural Components",Publisher-ELSEVIER, New Delhi, 2008(ISBN-8131214567)
2	Timoshenko,"Strength of Materials: vol. 2 ",Publisher-CBS Publishers & Distributors, 2002(ISBN-8123910770)

1. Subject Code: **AE323**   Course Title: **Finite Element Methods and Applications**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VI

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   To introduce the student with fundamentals of finite element method, Parametric element stresses and

strains, application of FEM in various mechanical field and use a software to perform analysis.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	Fundamental concepts of the Finite Element Method. Various element shapes, Displacement Model, Derivation of stiffness matrix for the element and for the entire domain.	9
2	ISO parametric elements Element stresses and strains.	9
3	Derivation of force and displacement vectors for the entire domain. Boundary conditions, Solution of the overall problems.	8
4	Applications of finite element method to various field problems such as solid mechanics, fluid mechanics and heat transfer.	8
5	Use of Software such as ANSYS/ NASTRAN/IDEAS. Basic feature of these softwares.	8
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	O.C. Zienkiewicz& R.A. Taylor,"Finite element Method",Publisher-Mc Graw Hill, 1989 (ISBN-0070991936)
2	C.S. Krishnamurthy,"Finite element Analysis",Publisher-Tata McGraw Hill Publishing Company limited(ISBN-0074622102)
3	Kenneth H. Hubener,"Finite element Method",Publisher-John Wiley & Sons,Inc(ISBN-0471370789)

1. Subject Code: **AE308**   Course Title: **Measurementand Instrumentation**
2. Contact Hours   : L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0
4. Relative Weight   **:** CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   : 4
6. Semester   : VI

7.	Subject Area	:	DEC
8.	Pre-requisite	:	NIL
9.	Objective	:	This course aims to introduce the student with general measurement systems, instruments used to measure various mechanical parameters, terminologies of various instruments, measuring of components.
10.	Details of Course	:	

S. No.	Contents	Contact Hours
1	**Basic concepts, Generalised Measurement System:** definition of terms, calibration, standards and errors, static and Dynamic performance characteristics; analysis of experimental data	8
2	Iinstrumentation for measurement of Position and displacement, force, Strain,pressure, temperature, proximity and range. Concept of feedback;	6
3	**open and close loop systems :** Loop control systems,transducers and devices for applications, digital readouts, data Acquisition and processing.	8
4	introduction, measuring instruments, measuring range, sensitivity, repeatability, precision and accuracy. Standards : definitions of line standard, end standard and wavelength standard, sub divisions of Standards. Slip gauges. Measurement of angles : introduction, bevel venire protractor, sine bar, angel gauges, spirit level, Autocollimator, angle dekkor, rotary tables, precision polygon, calibration of polygons. Measurement of internal and external tapers.	6
5	**Measurement of threads:** introduction, screw thread terminology, pitch error, angle error, measurement of major and minor diameter, measurement of effective diameter by one wire, two wire and three wire Method. Best size wire. Measurement of surface finish: introduction, surface texture, surface roughness terminologies, methods of measuring surface finish, stylus probe instruments, taylorhobsontalysurf, sample length or cutoff Length, analysis of surface traces.	8
6	**Gear measurements:** introduction, terminology of gear tooth, errors in manufacturing gears, rolling Test, measurement of tooth thickness, Parkinson gear tester. Inspection of straightness, flatness,	6

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	and alignment. Interferometry and use of optical flats. Measurement of coordinates using coordinate measuring machine.	
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	T.G.Beckwith,"Mechanical measurements", N. L. Buck and R. D. Marangoni, 3rd Ed, Narosa Publishing house.1993, ISBN 10: 0201004542 ISBN 13: 9780201004540
2	R. K. Jain,"Metrology",Khanna pub. 2002, ISBN-13978-81-7409-153/ISBN-1081-7409-153
3	C. Dotson,"Fundamentals of dimensional metrology", R. Harlow and R. Thomson. Pub. 2003, ISBN-13: 978-1418020620/ISBN-10: 1418020621
4	B. C. Nakra and K. K. Chaudhari,"Insrumentation, measurement and analysis",Tata McGraw-Hill, 19855, ISBN 0070482969, 9780070482968
5	E. O. Doeblin,"Measurement system- application and design, 4th Ed", Tata McGraw-Hill, 1990, ISBN-13: 978-0072922011/ISBN-10: 007292201X
6	Turner and Hill,"Instrumentation for Engineers and Scientists", Oxford university Press, ISBN-10: 0198565178ISBN-13: 978-0198565178

1. Subject Code: **AE310**   Course Title : **Advanced Manufacturing Technology**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40
                                PRE: 0
5. Credits   :   4
6. Semester   :   VI
7. Subject Area   :   DEC
8. Pre-requisite   :   NIL
9. Objective   :   This course aims to understand the functioning of new machining processes working on principle of non-thermal energy, Electro-chemical machines, laser beam machines, fabrication of semiconductors.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**NEWER MACHINING PROCESSES** (Non thermal energy) – Abrasive machining – water jet machining - ultrasonic machining - chemical machining – electro chemical machining – construction working principle – steps - types – process parameters – derivations – problems, merits, demerits and applications .	9
2	**NEWER MACHINING PROCESS –** Wire cut EDM - Electro chemical machining – ECG - Electric discharge machining – construction – principle – types – control - circuits – tool design – merits, demerits & applications.	8
3	**NEWER MACHINING PROCESS** – Laser beam machining – Electron beam machining – Plasma arc machining – Ion beam machining – construction working principle types – process parameter – derivations – problems, merits, demerits and applications.	9
4	**FABRICATION OF MICRO DEVICES** Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication.	8
5	**MICROFABRICATION TECHNOLOGY** Wafer preparation – monolithic processing – moulding – PCB board hybrid & mcm technology – programmable devices & ASIC – electronic material and processing.– steriolithography SAW devices, Surface Mount Technology	8
Total		**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	SeropeKalpakjian& Steven Schmid- Manufacturing Processes for Engineering Materials (5th Edition)– 2003,ISBN-13: 978-0132272711/ISBN-10: 0132272717
2	Julian W. Gardner,"Micro sensors Mems & smart devices—2002", Wiley-Blackwell, ISBN-13: 978-0471861096
3	Grahem T. Smith, "Advanced machining", I.F.S. UK 1989, ISBN-10: 0903608952/ ISBN-13: 978-0903608954
4	Jaeger R.C., "Introduction to microelectronic fabrication", Addison Wesley, 1988., ISBN-10: 0201444941/ISBN-13: 978-0201444940

5	NarioTaniguchi ,"Nano technology", Oxford University Press 1996.,
6	Pandey P.C. & Shan HS,"Modern Machining Processes", Tata McGraw-Hill Education, 1980, ISBN 0070965536, 9780070965539
7	More Madon, "Fundamentals of Microfabrication", CRC Press, 1997., ISBN 0849308267, 9780849308260

1. Subject Code: **AE312**   Course Title:**Quality Management & Six Sigma Applications**

2. Contact Hours   : L: 3 T: 0 P: 2

3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight   **:** CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0

5. Credits   : 4

6. Semester   : VI

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the student with quality, statistical control of processes, sampling process, ISO standards for six-sigma quality, life testing and reliability design.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction to Quality** : Definition of Quality- product, user, value, and manufacturing based perspectives, Dimensions of Quality, Quality Planning, Quality costs- optimization of quality costs, seven tools of quality control;Philosophies of Quality Gurus- Deming, Juran, Crosby, Feigenbaum, Ishikawa, Taguchi. Comparison of Quality Philosophies.	8
2	**Statistical Process Control** : Introduction to Qualitycharacteristics- variables and attributes, Types and causesof variations, Control Charts for variables and attributes,Process capability.	8
3	**Acceptance Sampling** : Sampling process and lots formation; Advantages and applications of acceptance sampling;characteristics of O.C. Curve; Single, double, multiple,sequential sampling; ASN, ATI, AOQL, AOQ, AQL, LQL,Producer's and Consumer's risks.	6

4	**Six Sigma and ISO 9000:2000** : Principles of Six Sigma,Statistical basis, Tools and techniques, DMAIC principle,application of six sigma in manufacturing and serviceorganizations, structure of ISO standards, Factors leading toISO, Implementation and registration, Benefits of ISO.	8
5	**Life Testing-Reliability** :Life testing: objective, failuredata analysis, MTTF, MTBF, hazard rate, exponential andWeibull models, system reliability-series, parallel and mixedconfigurations, Markov model.	8
6	**Reliability Design and Allocation** : Design for reliability, reliability improvement techniques, active redundancyand standby redundancy, K-out-of-N redundancy andmaintenance policies.	6
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	J R Evans and W M , "Lindsay The Management and Control of Quality", Cengage learning, India, ISBN-10: 0538452609/ISBN-13: 978-0538452601
2	KanishkaBedi,"Quality Management Oxford higher education", Oxford University Press, 2006, ISBN 0195677951, 9780195677959
3	Besterfield, "Total Quality Management", Pearson Education India, 2011, ISBN 8131732274, 9788131732274
4	F M Gryna, R C H Chua, J A DefeoJura,"Quality Planning and Analysis for Enterprise Quality", Tata McGrawHil, ISBN-10: 0072966629ISBN-13: 978-0072966626

1. Subject Code: **AE314**   Course Title:**Metrology**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   VI
7. Subject Area   :   DEC
8. Pre-requisite   :   NIL
9. Objective   :   This course aims to introduce the student with principles of measurement, types of standards, limits ,fits,

tolerances; measurement of angle, screw threads, gear measurement and testing on machines.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	Principles of measurement: Definition of Metrology, difference between precision and accuracy. Sources of errors: Controllable and Random Errors, Effects of Environment and Temperature, Effects of support, alignment errors, application of Least Square principles, errors in measurement of a quality which is function of other variables. Length Standards: Line standards, end standards and wavelength standards, transfer from line standards to end standards. Numerical based on line standards. Slip gauges – its use and care, methods of building different heights using different sets of slip gauges. Limits, fits and tolerances: Various definitions, IS9191963, different types of fits and methods to provide these fits. Numerical to calculate the limits, fits and tolerances as per IS 919- 1993. ISO system of limits and fits; Gauges and its types, limit gauges – plug and ring gauges. Gauge Design – Taylor's Principle, wear allowance on gauges. Different methods of giving tolerances on gauges,	8
2	Comparators: Characteristics, Uses, Limitation, Advantages and Disadvantages. Mechanical Comparators: Johanson Mikrokator and Signma Mechanical Comparator. Mechanical - optical comparator. Electrical and electronic comparators. Pneumatic comparators – Systems of Penumatic gauging: Flow type and back pressure type, different type of sensitivities and overall magnification. Solex Pneumatic gauge and differential comparators.	8
3	Angular Measurement: Sine Bar – different types of sine bars, use of sine bars in conjuction with slip gauges, precautions and calibration of sine bars. Use of angle gauges, spirit level, errors in use of sine bars. Numericals. Principle and working of Micro-optic autocollimator. Circular Division: dividing head and circular tables, circular division by precision Polygons. Caliper Principle, Calibration of polygons. Numerical based on circular division. Straightness and flatness: Definition of Straightness and Flatness	6

	error. Determination of straightness error of straight edge with the help of spirit level and auto collimator. Determination of flatness error of a surface plate with the help of spirit level or auto collimator. Numericals	
4	Screw Thread Measurement: Errors in threads, Measurement of elements of screw threads – major diameter, minor diameter, pitch, flank angle and effective diameter (Two and three wire methods). Effect of errors in pitch and flank angles and its mathematical derivation.	8
5	Gear Measurement: Measurement of tooth thickness – Gear tooth vernier caliper, Constant chord method, base tangent method and derivation of mathematical formulae for each method. Test plugs method for checking pitch diameter and tooth spacing. Measurement of Gear Pitch, Parkinson Gear Tester.	8
6	Machine Tool Alignment: Machine tool tests and alignment tests on lathe. Alignment tests on milling machine. Alignment tests on a radial drilling machine. Interferometry: Principle of measurement, Interferometry applied to flatness testing, surface contour tests, optical flats, testing of parallelism of a surface with the help of optical flat. Quantitative estimate of error in parallelism, Flatness Interferometer NPL-Gauge length interferometer for checking the error in slip gauges. Numericals based on Interferometry. Surface texture: Introduction, different types of irregularities, standard measures for assessment and measurement of surface finish.	6
Total		**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	R.K. Jain, "Engineering Metrology", Khanna Publishers, Delhi, BN 10: 817409153X ISBN 13: 9788174091536
2	I.C. Gupta, "Engineering Metrology", DhanpatRai Publications, Delhi, ISBN-10-8189928457
3	F.W. Galyer& C.R. Shotbolt, "Metrology for Engineers", ELBS edition.,ISBN-10: 0304318442/ISBN-13: 978-0304318445
4	R. Jenkins, "Fundamentals of Mechanical Inspection", Tata, McGraw Hill,
5	C. Dotson, R. Harlow, R. Thompson, "Fundamentals of Dimensional Metrology", Thomson Asia Pte Ltd., Singapore 6. A.S.T.M.E., "Handbook of Industrial Metrology", Prentice Hall, ISBN-10: 1418020621ISBN-13: 978-1418020620

1. Subject Code: **AE316**   Course Title: **Advances in Welding & Casting**

2. Contact Hours   : L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0

4. Relative Weight   **:** CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   : 4

6. Semester   : VI

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with the advances in welding and casting technology.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**CASTING DESIGN** Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering	9
2	**CASTING METALLURGY** Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy.	8
3	**RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT** Shellmoulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.	9
4	**WELDING METALLURGY AND DESIGN** Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.	8

80

5	**RECENT TRENDS IN WELDING** Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.	8
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers (TEXT BOOKS)
1	ASM Handbook, Vol 15, Casting, ASM International, 2004, ISBN 978-0871707116
2	ASM Handbook vol.6, welding Brazing & Soldering, ASM International, 2003, ISBN 978-0871703828
3	Parmer R.S., Welding Engineering and Technology, Khanna Publishers,2002, ISBN 9788174090287
4	Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002, ISBN 8174091599
5	HEINE, LOPER & ROSENTHAL, Principles of Metal Casting, Tata McGraw Hill, 2001, ISBN 0070993483
6	Jain P.L., Principles of Foundry Technology,TataMcGrawHill Publishers, 2003, ISBN 0070447608
7	Howard B. Cary, Scott C. Helzer , Modern Welding Technology, Pearson Prentice Hall Pvt Ltd., 2011, ISBN 0131836919
8	J. Piotrowski, W. Randolph , Robotic welding – A guide to selection and application, Society of Manufacturing, 1987, ISBN 0872632660
10	CORNU.J. Advanced welding systems – Volumes I, II and III, Springer Publishing, 2013, ISBN 3662110512
11	LANCASTER.J.F., Metallurgy of welding , Springer Publishing, 1987, ISBN 0046690107

1. Subject Code: **AE318**   Course Title: **Materials for Automobile Components**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   **:** CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   VI
7. Subject Area   :   DEC
8. Pre-requisite   :   NIL
9. Objective   :   This course aims to introduce the students with composites used for automobile components, types of composite material, constituents material used for composites and failure theories for composites.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction to Composites :** General Introduction and Concept, Historical Development, Concept of Composite Materials, Material Properties That Can Be Improved by Forming A Composite Material& Its Engineering Potential	4
2	**Basic Definitions and Classification of Composites :** Basic Definitions, Various Types of Composites, Classification Based on Matrix Material: Organic Matrix Composites Polymer Matrix Composites (PMC), Carbon Matrix Composites Or Carbon-Carbon Composites, Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMC); Classification Based on Reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites	6
3	**Advantages of Composites Materials :** Comparison With Metals, Advantages & Limitations of Composites	2
4	**Basic Constituents Materials in Composites:** Types of Reinforcements/Fibers Role and Selection Or Reinforcement Materials, Types of Fibers, Glass Fibers, Carbon Fibers, Aramid Fibers , Metal Fibers, Alumina Fibers, Boron Fibers, Silicon Carbide Fibers, Quartz and Silica Fibers, Multiphase Fibers, Whiskers, Flakes Etc., Mechanical Properties of Fibers. Matrix Materials : Functions of	10

	A Matrix, Desired Properties of A Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal Matrix, Ceramic Matrix, Carbon Matrix, Glass Matrix Etc Fibers Reinforcement Composite Materials (1 Hour) Fiber Reinforced Polymer (FRP) Laminated Composites Lamina & Laminate Lay-Up. Ph-Orientation Definition Behaviour of A Laminate-I: Isotropic Elasticity& Plane Stress Concept in 3-D Linear Elastic Stress-Strain Characteristics of FRP Composites, Stress and Strain Components in 3-D, Generalized Hooke's Law in 3-D, Stress-Strain Relations in 3-D for Isotropic Case.Anisotropic/Orthotropic Elasticity Stress-Strain Relations for Isotropic and Orthotropic Cases Torsional & Matrix Notations Concept of Cartesian Tensor, Indicial Notation and Torsional Representations in Elasticity, Voigt's Notations Behaviour of A Laminate-II: Mechanics of Load-Transfer in Laminate Mechanics of Load-Transfer in A Laminate Prediction of Engineering Property in A Laminate Laminate/Ply Stress-Strain Relations Lamina Stress-Strain A Relation in Material Coordinates, Transformation Relations, Lamina Stress-Strain Relations in Structure Global Coordinates Laminated Composites-I Mechanics of Plates/Kirchhoff's Plate Theory Concept of Laminate Laminate Strain-Displacement Relationship Based on Kirchhoff's Hypothesis Mechanical Behaviour of Unidirectional, Cross-Ply and Angle-Ply Structural Mechanics of Laminates Laminated Composites-II Structural Mechanics of Laminates Laminate Stiffness -Matrices Special Classification of Laminates Symmetric .Anti-Symmetric and Non-Symmetric Laminates Strength and Failure Concepts Strength of Laminates Failure Mechanics of Composites Macro-Mechanical Failure Theories Maximum Stress Theory, Maximum Strain Theory, Tsai-Hill Theory, Tsai-Wu Theory	
5	**Comparison of Failure Theories Design Concepts:** Design Issues Typical Structural Component Design Process Laminate Analysis/Design Software Composite Codes & Standards Manufacturing Processes Processing of Composite Materials Overall Considerations, Autoclave Curing, Other Manufacturing Processes Fiber-only Performs, Combined Fiber-Matrix Perform. Manufacturing Techniques: Tooling and Specialty Materials, Release Agents, Peel Plies, Release Films and Fabrics, Bleeder and Breather Plies, Bagging Films	10
6	**Special Topics :** Testing of Composites (ENGN4511) Mechanical Testing of Composites, Tensile Testing, Compressive Testing, Intra-	10

	Laminar Shear Testing, InterLaminar Shear Testing, Fracture Testing Etc Environmental Effects on Composites Micromechanics of Laminae Engineering Applications General Engineering Applications of FRP Composites Applications Related to Aerospace, Automobile, Bridge and Other Civil Engineering Structures, Case Studies	
	Total	**42**

11. **Suggested Books:**

S.No.	Name of Authors/Books/Publishers
1	Adanced Composite Materials for Automotive Applications : Structural Integrity and Crashworthiness/Ahmed Elmarakbi / John Wiley & Sons, 2013 / 111853526X, 9781118535264
2	Mechanics of Fibrous Composites / Carl T. Herakovich / Wiley, 1997 / 0471106364, 9780471106364

1. Subject Code: **AE320**   Course Title : **Tribology and Lubrication**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VI

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   This course aims to introduce student with general parameters for surface interaction, adhesive wear, friction between surfaces and lubrictaions.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction:** Surface interactions, science of rubbing surface, general consideration of parameters involved, wear rate, modeling and solution of simple problems	4

2	**Material properties influencing interactions:** Introduction, elastic properties, Plastic deformation properties, relation between the strength and other Properties of solids, chemical reactivity of surfaces, absorbed surface layer, Surface energy, relation between surface energy and hardness, Surface Interfacial Energies of Solids under engineering condition	8
3	**Surface Interaction:** Size of real contact area and effect of surface energy, size of junction, rheologial properties, Wear in tribological joints - classification, calculation methods with allowance for stiffness, wear limits, reliability of joints, simple examples, detailed study of manufacturing methods for highly reliable joints. Economic role of wear, measurement, types, and use of radiotracer techniques	8
4	**Adhesive wear:** Mechanism, size, shapes of transferred and wear particles, quantitative laws, equilibrium calculation of fragments under different conditions, minimum load for loose particle formation, Quantitative expression for abrasive wear, of hardness and particle size on abrasive wear rate, surface fatigue wear, brittle fracture wear, corrosive wear with types	8
5	**Friction**: Introduction, laws, function, properties of uncontaminated metals in air, outgassed metal surface, calculation of flash temperature using surface energy, stickslip and its prevention	6
6	**Lubrication:** Solid film lubrication, boundary lubrication with single and multiple penetration models, properties of lubricants, effectiveness of lubrication-intermediate temperature, behavior of a solid lubrication below melting point effect of speed, load on lubrication. Lubricants, their properties lubrication technique in vacuum, lubricant coating and its stability. Theory of elastohydrodynamic lubrication film thickness, frictional stress heat flow & temperature, service life of roller bearings	8
Total		**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Gwidon, Stachowiak, Engineering Tribology 2005 Edition, Publisher-Elsevier (ISBN -13: 9780123970473)
2	GwidonStachowiak;Experimental Methods in Tribology Publisher-Elsevier (ISBN -13: 9780444515896)

3	John Williams,Engineering Tribology OUP Publisher: Cambridge University Press (ISBN-13: 9780521609883)

1. Subject Code: **AE322**   Course Title : **Reliability& Maintenance Engineering**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.) :   Theory: 3   Practical: 0

4. Relative Weight   **:**   CWS: 15   PRS: 25 MTE: 20   ETE: 40 PRE: 0

5. Credits   :   4

6. Semester   :   VI

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   This course is designed to introduce the student with mathematics of reliability, system reliability assessment, availability and maintainability.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction and Reliability Mathematics :** Relevance of reliability, availability and maintainability, definition of reliability, factors influencing system effectiveness, laws of probability, probability distributions; exponential Weibull normal, log normal, data collection recovery of data, Statistical analysis of failure data	4
2	**Fundamentals Of Reliability :** Various reliability related functions; probability density function, cumulative distribution function, reliability function and hazard rate; reliability models; constant rate, Weibull, normal and lognormal model	8
3	**System Reliability Assessment :** Types of systems- series, parallel, series-parallel, parallel-series, stand by and complex; method of reliability evaluation; cut set and tie set methods, event trees and fault trees methods, markov method, Reliability of repairable systems	8
4	**Reliability Improvements :** Methods of reliability improvements,; low level and high level redundancy, active , stand by and K-out-of-N redundancy, effect of maintenance	8

5	**Availability and Maintainability Assessments** : Point, mission and steady state availability. Availability assessment, Maintainability and its assessment. Maintenance policies	6
6	**Design for Reliability** : Reliability allocation, Design for reliability and maintainability, optimization of reliability and maintainability and their trade-off, Practical applications of RAM Engineering to systems, products and processes., Monte Carlo simulation	8
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Ebeling CharlesE.,"An introduction to Reliability and Maintainability Engineering", Publisher: Tata McGraw-Hill Publishing Co. Ltd.,New Delhi(ISBN-13: 9780070188525), 1996
2	Srinath,L.S." Reliability Engineering",PUBLISHER :Affiliated East – West Press Ltd., New Delhi(ISBN: 978-81-317-2121-6),1991
3	Dhillon,B.S.,"Engineering Maintainbility",PUBLISHER: Prentice Hall of India, New Delhi(ISBN: 9780080505688),1991
4	Blanchard, Benjamin,S.,"Logistics Engineering and Management", PUBLISHER:Prentice Hall of India, New Delhi(ISBN: 9780131246997),2004

1. Subject Code: **AE324**   Course Title: **Elastic & Plastic Behavior of Material**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VI

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   To introduce the student with mechanical testing, behaviour of material beyond elastic limit, creep and fatigue.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Mechanical Testing:** Study of stress strain diagrams of various materials	4
2	tension, compression, shear and ductile tests, bend test and Erichsoncuppling tests on Rockwell, Brinell, Vickers hardness tests; micro hardness, superficial and shore's schleroscope tests	8
3	**Material Behavior Beyond Elastic Limit**: Inelastic action, yielding in crystals, dislocations, yielding in polycrystals and amorphous material, UNIIT III Strain hardening and discontinuous yielding.	8
4	**Fracture:** Study of ductile and Brittle fracture; Ductile - Brittle transition, notch effect and notch sensitivity and methods of protection against fracture	6
5	**Creep:** Long- time constant load, Constant-temperature creep tests, mechanism of creep rupture, graphical representation of long time creep test data, empirical relation for creep behavior, plastic flow rules for creep, creep relaxation in tension	8
6	**Fatigue:** The nature of fatigue, mechanism of fatigue, fatigue strength of metals, stress concentration, fatigue strength, fatigue failure under combined stress, cumulative fatigue damage due to varying amplitude of stress, other factors affecting fatigue strength	8
	Total	**42**

11.   **Suggested Books:**

S.no.	Name of author/book/publisher
1.	W A Nash "strength of materials", The McGraw-Hill Companies (ISBN-9780070843660)
2.	R.K.BANSAL, "strength of materials", Laxmi publication, 2010 (ISBN-9788131808146)
3.	SADHU SINGH, "strength of materials", Khanna Publishers. Publication Year: 2009. ISBN-13: 9788174090485
4.	W. JHONES, "impact strength of material", Edward Arnold ISBN-13: 978-0713132663

1. Subject Code: **AE326**   Course Title: **Production Planning & Inventory Control**
2. Contact Hours   : L: 3   T: 0   P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight   **:** CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   : 4
6. Semester   : VI
7. Subject Area   : DEC
8. Pre-requisite   : NIL
9. Objective   : To familiarize the students with the production planning and inventory control system.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**INTRODUCTION**Objectives and benefits of planning and control-Functions of production control-Types ofproduction-job- batch and continuous-Product development and design-Marketingaspect -Functional aspects-Operational aspect-Durability and dependability aspectaestheticaspect. Profit consideration-Standardization, Simplification & specialization-Break even analysis-Economics of a new design	8
2	**WORK STUDY**Method study, basic procedure-Selection-Recording of process - Critical analysis,Development - Implementation - Micro motion and memo motion study – workmeasurement - Techniques of work measurement - Time study - Production study -Work sampling - Synthesis from standard data - Predetermined motion time standards	8
3	**PRODUCT PLANNING AND PROCESS PLANNING** Product planning-Extending the original product information-Value analysis-Problems inlack of product planning-Process planning and routing-Pre requisite information neededfor process planning-Steps in process planning-Quantity determination in batchproduction-Machine capacity, balancing-Analysis of process capabilities in a multiproduct system	8
4	**PRODUCTION SCHEDULING**Production Control Systems-Loading and scheduling-Master Scheduling-Schedulingrules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance –	8

	Flowproduction scheduling-Batch production scheduling-Product sequencing - ProductionControl systems-Periodic batch control-Material requirement planning kanban –Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques foraligning completion times and due dates	
5	**INVENTORY CONTROL AND RECENT TRENDS IN PPC**Inventory control-Purpose of holding stock-Effect of demand on inventories-Orderingprocedures. Two bin system -Ordering cycle system-Determination of Economic orderquantity and economic lot size-ABC analysis-Recorder procedure-Introduction tocomputer integrated production planning systems-elements of JUST IN TIMESYSTEMS-Fundamentals of MRP II and ERP	10
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	MartandTelsang ,"Industrial Engineering and Production Management", Publisher-S.Chandand Company, First edition, 2000 (ISBN 8121917735)
2	James.B.Dilworth,"Operations management – Design, Planning and Control formanufacturing and services" Mcgraw Hill International edition1992
3	Samson Eilon , "Elements of production planning and control", , Publisher- Universal BookCorpn.1984 (ISBN 13: 9780023318009)
4	Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / OperationsManagement", Publisher 8th Ed. John Wiley and Sons, 2000 (ISBN 13: 9780471056720)
5	Melynk, Denzler," Operations management – A value driven approach" Publisher-IrwinMcgrawhill (ISBN -13: 9780256123814)

1. Subject Code: **AE411**   Course Title: **Vehicle Maintenance &Tribology**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VII

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   To familiarize the students with the engine maintenance parameters, schedules, chasis maintenance of electrical systems, cooling systems, lubrication system.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction :** nature of surfaces and contact, surface topography, friction and wear mechanisms and effect of lubricants, methods of fluid film formation. Lubrication Choice of lubricant type, oil, grease and solid lubricants, additives, lubrication systems and their selection, selection of pump, filters, piping design, oil changing and oil conservation. Failure of tribological components filure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using SOAP and Ferrography	6
2	**Maintenance of records and schedules :** Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) Maintenance, requirements of maintenance, preparation of check lists. Inspection Schedule, maintenance of records, log sheets and other forms, safety precautions in Maintenance	6
3	**Engine maintenance** – repair and overhauling Dismantling of engine components and cleaning, cleaning methods, visual and Dimensional inspections, minor and major reconditioning of various components, Reconditioning methods, engine assembly, special tools used for maintenance Overhauling, engine tune up. Performance evaluation for maintenance	8
4	**Chassis maintenance - repair and overhauling :** Mechanical and automobile clutch and gear box, servicing and maintenance, Maintenance servicing of propeller shaft and differential system. Maintenance &servicing of suspension systems. Brake systems, types and servicing techniques. Steering Systems, overhauling and maintenance. Wheel alignment, computerized alignment and Wheel balancing	8
5	**Maintenance of automotive electrical system servicing and repairs :**Testing methods for checking electrical components, checking battery, starter motor, Charging systems, dc generator and alternator, ignitions system, lighting systems. Fault Diagnosis and	8

	maintenance of modern electronic controls, checking and servicing of Dash board instruments	
6	**Maintenance of fuel system, cooling systems, lubrication system and vehicle Body :** Servicing and maintenance of fuel system of different types of vehicles, calibration and Tuning of engine for optimum fuel supply. Cooling systems, water pump, radiator, Thermostat, anticorrosion and antifreeze additives. Lubrication maintenance, lubricating Oil changing, greasing of parts. Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance	6
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	John Doke "Fleet Management", McGraw-Hill Co. 1984
2	Fraze,prving " Automotive Maintenance & Troubleshooting". Mir Publishers, Moscow1976
3	Fundamentals of Tribology -S. K. Basu, S.N. Seengupta& B.B. Ahuja- PHI 4. Engineering Tribology - PrasantaSahoo -PHI
4	James D Halderman ," Advanced Engine Performance Diagnosis",Publisher: Prentice Hall (ISBN-13: 9780130929846),1998
5	Service Manuals from Different Vehicle Manufacturers
6	Neale M J "Tribology Handbook" publisher: Butterworth-Heinemann (ISBN-13: 9780750611985), 1975
7	J J O' Connor & Boyd ASLE, "Standard handbook of lubrication engineers", publisher- McGraw Hill Book Co.(ISBN-13: 9780070476059),1968

1. Subject Code: **AE413**   Course Title: **Vehicle Transport Management**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   **:**   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   VII
7. Subject Area   :   DEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with concept of vehicle transport management. To familiarize him with understanding about vehicle transport management.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**INTRODUCTION :**Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests	8
2	**TRANSPORT SYSTEMS** :Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings	8
3	**SCHEDULING AND FARE STRUCTURE** :Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling	10
4	**MOTOR VEHICLE ACT** :Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive	8
5	**MAINTENANCE** :Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout	8
Total		**42**

S. No.	Name of Authors /Books / Publishers
1	John Duke ,"Fleet Management",–Publisher- McGraw-Hill Co, USA (ISBN -13: 978-0070174108), 1984
2	Kitchin.L.D ,"Bus Operation"., Publisher - Illiffee and Sons Co., London, III edition (ISBN: B0007JG0US), 1992
3	Government Motor Vehicle Act –Publication on latest act to be used as on date

1. Subject Code: **AE415**   Course Title: **Power Plant Engineering**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.) :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   VII
7. Subject Area   :   DEC
8. Pre-requisite   :   NIL
9. Objective   :   To familiarize the students with types of power plants, steam generators, combined cycle power plants, other power plants, control of power plants and environmental impact of power plants.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Classification of power plants**: base load and Peak load power stations, co-generated power plant, captive power plant, and their fields of application & selection criteria, Indian energy scenario, Indian coals: formation, properties, analysis, benefication and heating value calculation of coals; cocking and non-cocking coals, fuel handling systems; coal gasification	6
2	**Steam Generators**: High pressure utility boiler, natural and forced circulation, fuel handling, coking and non-coking coal, coal benefication, coal pulverization, pulverized fuel firing system, combustion process, need of excess air, cyclone furnace, fluidized bed boiler, placement	8

	of evaporator, economizers, super heaters, re-heaters, air pre-heater in the boiler, de-aeration, boiler blow- down, ash collection by bag house, gravity separation, electrostatic precipitators and wet scrubbers, boiler efficiency calculations, water treatment: external and internal treatment	
3	**Combined Cycle Power Plants:** Binary vapour cycles, coupled cycles, gas turbine- steam turbine power plant, gas pipe line control, MHD- Steam power plant, thermionic steam power plant, integrated coal combined cycle (IGCC) power plant	6
4	**Other power plants :** Nuclear power plants - working and types of nuclear reactors, boiling water reactor, pressurized water reactor, fast breeder reactor, controls in nuclear power plants, hydro power plant -classification and working of hydroelectric power plants, diesel and tidal power plants	8
5	**Instrumentation and Controls in power plants**: Important instruments used for temperature, flow, pressure, water/ steam conductivity measurement; flue gas analysis, drum level control, combustion control, super heater and re-heater temperature control, furnace safeguard and supervisory system (FSSS), auto turbine run-up system(ATRS), interlocks and protection of boiler turbines	8
6	**Environment Pollution and Energy conservation**: Economics of power generation: load duration curves, power plant economics, pollution from power plants, disposal/ management of nuclear power plant waste. concept of energy conservation and energy auditing	6
Total		**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	M.M. El Wakil, "Power Plant Engineering", Publisher-Tata McGraw Hill (ISBN 13: 9780072871029)
2	P.K Nag , "Power Plant Engineering", Publisher-Tata McGraw Hill(ISBN-13: 9789339204044)
3	by J Wiesman and R Eckart, "Modern Power Plant Engineering", Publisher-Prentice hall India Ltd (ISBN 9780135972526)
4	T.D Eastop and McConkey ."Applied Thermodynamics", Longman Scientific and Technical Publisher-Pearson (ISBN 8177582380)

5	F.S Aschner "Planning Fundamentals of thermal Power Plants", Publisher-John Wiley (ISBN 9780470993569)

1. Subject Code: **AE417**   Course Title: **Robotics &Automation(DEC-5)**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3   Practical: 0
4. Relative Weight   **:**   CWS: 15 PRS: 25   MTE: 20   ETE: 40 PRE: 0
5. Credits   :   4
6. Semester   :   VII
7. Subject Area   :   DEC
8. Pre-requisite   :   NIL
9. Objective   :   To introduce the student with types of robotics, fundamentals of robotics, languages used to program robots, sensing system for a robot and safety of robots.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction to Robotics**, Classification of Robots, Characteristics of Robots, performance, advantages and disadvantages of a Robot, industrial applications of a Robot	6
2	**Fundamentals of a Robot:** Various system, structure and definition, terms relating to industrial Robots, basic terms related to Robot performance and Characteristics, Control volume of a Robot	6
3	**Robot languages and programing**	8
4	**Controlling the Robot systems:** Introduction to drives, Mechanical, Hydraulic, Pneumatic, electric drives, feed back control	8
5	**Sensing system for a robot:** Introduction, types of sensors, machine vision, Artificial intelligence, Control techniques	8
6	**Robot safety:** Introduction, potential safety hazards, safety planning check lists, safety guidelines, latest development in safety measurement	6
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	John j Craig, "Introduction to Robotics: Mechanics and Control", Publisher-Pearson education (ISBN 9780201543612)
2	Y.Koren "Robotics for Engineers", Publisher-McGraw Hill Publications(ISBN 9780070353992)

1. Subject Code: **AE419** Course Title: **Nuclear Energy**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight **:** CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the nuclear physics, nuclear energy, principles of nuclear reactors, types of reactors, heat transfer involved in reactors and waste management of radiative material

10. Details of Course :

S. No.	Contents	Contact Hours
1	**Nuclear Physics:** Atomic number and mass numbers, Isotopes, Nuclear energy and nuclear forces, Binding Energy, Nuclear Stability, Radioactivity, Nuclear reactions, Radioactive isotopes, Law of radioactivity, Interaction of radiation (alpha,beta, gamma) with matter, Interaction of neutrons with matter, Absorption radiative capture, Transmutation Fission, Cross section for nuclear reactions. Fission process, Mechanism of nuclear fission, fission cross section, fission products, Basic radio chemistry	6
2	**Reactor Physics:** Neutron balance, Neutron diffusion, Diffusion equation, and its solution, Showing down of neutrons, Showing down power and moderating ratio. Reactor theory: Multiplication factors, Four factor formula, One group critical equation, Age, Diffusion method,	8

	Nonleakage probabilities and effective multiplication factor, Multi group diffusion theory, Homogeneous and heterogeneous reactor systems, Time dependent reactor behaviour	
3	**Nuclear Reactor Engineering:** Types of rectors, Ordinary water moderated reactors (BWR, PWRO), Heavy water cooled and moderated reactors, Gas cooled reactors (HTGR, AGR), Fast reactors design, Construction and control of nuclear reactors	8
4	**Heat transfer in nuclear reactors:** Heat transfer techniques in nuclear reactors, Design and operation, Thermal stresses, Reactor shielding	6
5	**Reactor materials:** Nuclear fuels, Moderators, Coolants, Reflectors and structural materials. Reprocessing: Nuclear fuel cycle, Spent fuel characteristics, Reprocessing techniques role of solvent extraction in reprocessing	6
6	**Waste management and radiation protection:** Types of waste, Waste management philosophy and disposal, ICRP recommendations, Radiation hazards and their prevention, Radiation dose units. Status of nuclear technology in India: Indian nuclear power program, Nuclear reactors in India, India's commitment to nuclear	8
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	S. Glasstone and A. Seronske, Van Nostrand – Reinhold , "Nuclear Reactor Engineering", Publisher- Technical Information Center, United States Atomic Energy Commission(ISBN 9780870790096), 1967
2	M. Bendict and T.A. Pigtor ,"Nuclear Chemical Engineering", Publisher- McGraw Hill, 1981(ISBN: 0070045313)
3	L. C. MerriteBasic Principles of Nuclear Science and Reactors, Publisher-Wiley Hill, 1981
4	S. E. Liverhandt, Introduction to Nuclear Reactor Physics (ISBN -13: 9781124145884)

1. Subject Code: **AE-404**   Course Title: **Computer Integrated Manufacturing Systems (DEC- 6,7,8)**

2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   **:** CWS: 15   PRS: 25 MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   VIII
7. Subject Area   :   DEC
8. Pre-requisite   :   NIL
9. Objective   :   To familiarize the students with CIMS, Part Programming, Tooling and Fixture, Work piece Handling etc.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction :** Fundamental Concepts in Manufacturing and Automation- Need for Automation - Automation Strategies- Economic Analysis and Production - Fundamental of CIMS	8
2	**Computer Aided Design (CAD) :** Elements of CAD System- Graphics Hardware - ALU- CPU - Input/Output Devices -Geometric Modeling - Automated Drafting	8
3	**Manufacturing Systems :** Basics of Numerical Control – Types of NC Systems - CNC and DNC Machines - Matching Centre– Tool Magazine - NC Tape Format - Programming – Manual Part Programme - Simple Programmes - Computer Assisted Part Programming - APT Language - Simple Examples	8
4	**Flexible Manufacturing Systems :** Group Technology - Part Families - Part Classification and Cooling – ProductionFlow Analysis - Machine Cell Design - Description of FMS -Equipment, Tooling and Fixture	8
5	**Computer Aided Manufacturing :** Computers in Manufacturing - Automated Manufacturing Systems -Workpiece Handling - Types of Transfer - Continuous,Intermittent and Non-Synchronous Walking Beam -Computer Aided Process Planning – Computer AidedInspection - Computer Aided Quality Control - Basic Model	10

off CIMS- Interfacing Methods of CAD And CAM – Computer Process Monitoring	
Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Automation, Production Systems, and Computer-Integrated Manufacturing/Mikell P. Groover/Pearson Education, 2015/0133499715, 9780133499711
2	CAD/CAM: Computer-Aided Design and Manufacturing/Groover/Pearson Education India, 1984/8177584162, 9788177584165
3	Niebel, " Modem Manufacturing Process ", Mcgraw-Hill, 1989
4	Numerical Control of Machine Tools/Stanley John Martin/English Universities Press, 1970/0340114576, 9780340114575
5	Computer Integrated Manufacturing: From Fundamentals to Implementation/Alan Weatherall/Butterworth-Heinemann, 2013 / 1483163415, 9781483163413

1. Subject Code: **AE406**   Course Title: **Total Life Cycle Management**

2. Contact Hours   : L: 3   T: 0   P: 2

3. Examination Duration (Hrs.) : Theory: 3   Practical: 0

4. Relative Weight   **:** CWS: 15   PRS: 25   MTE: 20   ETE: 40 PRE: 0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with the concept of Total Life Cycle, management of old vehicles, applying life cycle thinking to define tradeoffs. This course also introduces to sustainability, use of renewable resources.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction :** Definition of Total Life Cycle (TLC) – Conceptof TLC - Life Cycle Impacts - Integrating Life Cycle Technologies- Products and Processes Within TLC - TLC Methodology- TLC Accessement Data to Complex Products – ResultantImprovement for Product	8
2	**Vehicles End of Life** : Design for End of Old VehicleManagement - Problems of Old Vehicles in EmergingMarkets - Recovery and Economic Feasibility of MaterialsSuch As Plastic, Rubber, Aluminium, Steel, Etc	8
3	**Tradeoffs :** Applying Life Cycle Thinking to Define Tradeoffs Along the Supply, Manufacture - Use and End of Life Chain- Effects on the Customer - Expectation of the Customer -Evaluate Product Cost on Fuel Consumption, Emission,Durability, Environment and Health	10
4	**Sustainability :**What Is Sustainability - Use of RenewableResources - View to Design Horizon.	8
5	**Harmonization of Environmental Goals :** Tlc for Emerging Vs Developed Markets - Rules and Regulations to Guide Designers - International Common Practices for End of LifeVehicles	8
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Life Cycle Management Case Study of an Instrument Panel /SAE, 1997/
2	Accident Reconstruction: Automobiles, Tractor-semitrailers, Motorcycles, and Pedestrians /Society of Automotive Engineers, 1987 /0898834546, 9780898834543

1. Subject Code: **AE408**   Course Title: **Refrigeration & Automobile Air Conditioning**

2. Contact Hours   : L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0

4. Relative Weight   : CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   To familiarize the students with the basic concepts of Refrigeration and Air conditioning principles of designing and maintenance of air-conditioning system.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Refrigeration**Refrigeration, ton of Refrigeration, Various Methods of Producing Refrigeration, Applications, Heat Pump, Reversed Carnot Cycle and Its Limitations, Vapour Compression Cycle, Subcooling, Superheating, Liquid Vapour Heat Exchanger, Effect of Changes in Evaporator Condenser Temperatures, Deviations From Ideal Cycle. Refrigerants and Their Properties, Alternative Refrigerants	10
2	**AIRCONDITIONING FUNDAMENTALS** Basic air conditioning system - location of air conditioning components in a car, schematic layout of a refrigeration system, compressor components, condenser and high pressure service ports, thermostatic expansion valve, expansion valve calibration, controlling evaporator temperature, evaporator pressure regulator, evaporator temperature regulator	10
3	**AIR CONDITIONER – HEATING SYSTEM**Automotive heaters, manually controlled air conditioner, heater system, automatically controlled air conditioner and heater systems, automatic temperature control, air conditioning protection, engine protection	7
4	**AIR ROUTING AND TEMPERATURE CONTROL** Objectives, evaporator airflow through the recirculation unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control and handling systems	7
5	**AIR CONDITIONING SERVICE**Air conditioner maintenance and service, servicing heater system removing and replacing components, trouble shooting of air controlling system, compressor service	8
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	William H. Crouse and Donald I. Anglin - "Automotive Air conditioning" – McGraw Hill Inc. – 1990, ISBN: 9780070148574
2	Boyce H.D Wiggins -"Automotive Air Conditioning" - Delmar – 2002, ISBN:10:0827319428/ISBN: 13:9780827319424
3	Mitchell information Services, Inc - "Mitchell Automatic Heating and Air Conditioning Systems" - Prentice Hall Ind. – 1989, ISBN: 13:978-0135862230, 10:013586223X
4	Paul Weiser - "Automotive Air Conditioning" - Reston Publishing Co., Inc., - 1990, ISBN: 978-0835902618
5	MacDonald, K.I., - "Automotive Air Conditioning" - Theodore Audel series – 1978,ISBN: 0672233185 9870672233180
6	Goings.L.F. – "Automotive Air Conditioning" - American Technical services -1974, ISBN: 978-0826902108

1. Subject Code: **AE410**   Course Title: **Fuel Cells**
2. Contact Hours   : L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0
4. Relative Weight   : CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   : 4
6. Semester   : VIII
7. Subject Area   : DEC
8. Pre-requisite   : NIL
9. Objective   : To familiarize the students with the concepts and analysis of fuel cells.Tofamiliarize the student about conventional and latest trends in this area.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction and Thermodynamics : Introduction:** Basic Operating Principles – Historical Highlights – Classification. **Thermodynamics:**Electrochemical Energy Conversion – Theoretical Efficiency – Electrochemical Energy Conversion – Factors Affecting Electrochemical Energy Conversion	6

2	**Electrode Kinetics :** Electrode Double Layer – ElectrolyteDouble Layer – Double Layer Models (Helmoltz Model, Gouy-Chapman Model, Stern Model, Grahame Model – Bockris,Devenathan and Muller Model, and Chemical Models)– Solid Metallic Electrode – Semiconductor Electrode –Specific Adsorption – Zero Potential	8
3	**Alkaline Fuel Cells & Phosphoric Acid Fuel Cells : Alkaline Fuel Cells:** Working Principle – Components – Modules andStacks – Performance Characteristics (Power Density, SpaceApplications, Atmospheric Pressure Cells) – Limitations and R&D Challenges – System Issues – Ammonia As Fuel. Phosphoric Acid Fuel Cells: Cell Reactions – Electrodes (Stability of Catalysts, Electrode Fabrication – Fuel Cell Performance) – Stacks and Systems	8
4	**Solid Oxide Fuel Cells & Molten Carbonate Fuel Cells : Solid Oxide Fuel Cell:** Principle of Operation – Benefitsand Limitations – Cell Components (Electrolytes, ZirconiaSystems, Ceria Based Electrolytes, Perovskite-Based Systems)– Cathode Materials – Anode Materials Interconnects –Fuel Reactions –Configurations and Performance (Tubular,Monolithic, Planar) – Environmental Impact –Applications.Molten Carbonate Fuel Cell: General Principle – Components(Electrolyte and Matrix, Cathode and Anode Materials) –Electrode Reactions – Life Time	10
5	**Direct Methanol Fuel Cells & Proton Exchange Membrane Fuel Cells : Direct Methanol Fuel Cells:** Operating Principle– Noble Metal Issue – Electro-Oxidation of Methanol(Catalysts, Oxygen Electro-Reduction, Electrolyte, Non-Catalytic Aspects) - Methanol Crossover – CatalystOptimization – Vapour Feed Versus Liquid Feed Cells.Proton Exchange Membrane Fuel Cells: Operating Principle(Membranes, Electrodes and Electrolysis, Optimization of Membrane and Electrode Assembly Impurities) – Technology Development (Single Cell and Stacks, Composite Plates) – Fuel Processing – Modeling Studies (Membrane, Electrode, Membrane-Electrode Assembly, Fuel Cell, Stack and System) – Technology Development and Applications	10
	Total	42

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Viswanathan, B. and AuliceScibioh, M., Fuel Cells Principles and Applications, Universities Press (India) Pvt. Ltd., Hyderabad, 2006, ISBN:9781420060287 1420060287
2	Hoogers, G., Edr., Fuel Cell Technology Handbook, Crc Press, Washington D. C., 2003, ISBN:9780849308772

1 Subject Code: **AE412**   Course Title: **Modern Vehicle Technology**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VIII

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   To familiarize the students with modern vehicles, trends in power plants, new techniques of reduction of noise and pollution; vehicle automated tracks.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Trends in Power Plants** : Hybrid Vehicles - Stratified Charged/ Learn Burn Engines - Hydrogen Engines - Battery Vehicles– Electric Propulsion With Cables - Magnetic Track Vehicles	6
2	**Suspension Brakes and Safety :** Air Suspension – Closed Loop Suspension - Antiskid Braking System, Retarders,Regenerative Braking Safety Cage - Air Bags - Crash Resistance- Passenger Comfort	8
3	**Noise and Pollution :** Reduction of Noise - Internal & External Pollution ControlThrough Alternate Fuels/Power Plants – Catalytic Converters and Filters for Particulate Emission	8
4	**Vehicle Operation and Control :** Computer Control for Pollution and Noise Control and for Fuel Economy -Transducers and Actuators	10

	- Information Technology forReceiving Proper Information and Operation of the Vehicle Like Optimum Speed and Direction	
5	**Vehicle Automated Tracks :** Preparation and Maintenanceof Proper Road Network - National Highway Network WithAutomated Roads and Vehicles - Satellite Control of VehicleOperation for Safe and Fast Travel	10
	Total	**42**

11.   **Suggested Books :**

S. No.	Name of Authors /Books / Publishers
1	Noise and Vibration control engineering : principles and applications / Istvan L.Ver, Leo Leroy Beranek John Wiley & Sons, 2006//0471449423, 9780471449423
2	Automotive Handbook/Robert Bosch, Robert Bosch GmbH./SAE, 1993/0837603307, 9780837603308

1. Subject Code: **AE414**   Course Title: **Automobiles Vibration System Analysis**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VIII

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   This course aims to introduce the student with fundamentals of vibrations, multi-degree of freedom systems, dynamic analysis and frequency analysis.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction:** Simple Harmonic Motion, Terminology,Newton's Law, D'alembert'sPrinicple, Resonance,Introduction to Mechanism of Damping. Damped andUndamped Oscillations. Degrees of Freedom. VariousMechanisms of Damping. Equivalent Viscous Damping	6

2	**Single Degree of Freedom Systems:** Free Vibrations, FreeDamped Vibrations, Forced Vibrations With and WithoutDamping. Support Excitation and Vibration MeasuringInstruments. Amplitude and Phase Response Diagrams.Generalized Single Degree of Freedom Systems forContinuous Structures and Computation of K, M and C.	8
3	**Multi Degree of Freedom Systems:** Two / Three Degree of Freedom Systems, Static and Dynamic Coupling, VibrationAbsorbers, Principal Coordinates, Principal Modes,Othogonality Conditions Hamilton's Principle, Lagrange'sEquation and Application. Longintudinal Vibration, LateralVibration, Torsional Vibration of Shafts, Dynamical Equations of Equilibrium of Elastic Bodies, Natural Frequenciesand Modeshapes Determination	8
4	**Frequency Analysis:** Methods Determining NaturalFrequencies and Mode Shape. Natural Vibrations of SolidContinua. Determination of Eigen Values and Eigen Modes.Introduction to Approximate Methods for Frequency Analysis Rayleigh Ritz Method for Vibration Analysis. Diagonalization of Stiffness, Mass and Damping MatricesUsing Orthogonality Conditions	10
5	**Dynamic Analysis:** Matrices for Dynamic Analysis.Kinematically Consistent Load Systems and Determination of [K], [M], [C] and [L] Matrices. Normalization and Formulationof Modal Equations. **Steady State Analysis:** Steady State Response, Using Fourier Analysis for Decomposing Complex Periodic Load Functions, of Modal Equations Using S-Plane Representation. Transient Response Analysis of Modal Equations Using Duhamel's Integrals	10
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Theory of vibration with applications / William Tyrrell Thomson / Prentice-Hall, 1972 /0139145494, 9780139145490
2	Mechanical Vibrations/New Chand, 2009 / 8185240566, 9788185240565
3	Introductory Course on Theory & Practice of Mechanical Vibrations / J.S. Rao, Dr. K. Gupta / Wiley Eastern, 1984 / 0852267835, 9780852267837
4	Mechanical Vibrations / Rao / Pearson Education India, 2003 / 8177588745, 9788177588843

1. **Subject Code:** AE416   **Course Title:** Renewable Sources of Energy

2. Contact Hours   : L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0

4. Relative Weight   : CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with renewable energies used for automobiles, types of biofuels, alcohol fuels and automotive applications of these sources.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Solar Energy :** Conversion of Solar Energy to Electrical Energy- Availability - Advantages and Limitations – Power Systems	6
2	**Wind Energy :** Wind Mapping - Location of Wind Generators- Types of Wind Mills and Generators - Induction andSynchronous Systems	6
3	**Bio-fuels :**Sources of Bio-Mass Energy - Wood andAgricultural Waste - Municipal Waste - Animal Waste – EnergyConversion Systems - Biogas Generation From Animal Waste- Wood Gasification - Downdraft and Fluidised Bed Systems- Alcohol Fuels. Properties as engine fuel, alcohols blendingwith diesel and gasoline, their performance and emissionscharacteristics, DME, DEE properties and performance andemissions characteristics.**Vegetable Oils :** Conversion of vegetable oils as biodiesel –production techniques - standards and properties - performance and Emission characteristics, additives	10
4	**Alcohol Fuels** : Properties as engine fuels - performance in SI engines - blending with gasoline - Reformed alcohols –Use in CI engines - emulsions - dual fuel systems –sparkassisted diesel engines - combustion and emissioncharacteristics	8
5	**Other Sources :** Wave Energy - Scope and Simple Systems for Power Generation - Tidal Power - Scope and Applications. Otec	6

	Scope Fundamental Principles and Operating Systems for Power Generation. Geo Thermal Energy - Principle and Simple Systems for Power Generation	
6	**Automotive Applications :** Electric Car Operation With Energy Stored in Battery – Energy Converted to Hydrogen Engine Operation Hydrogen Conversion and Storage System - Relative Merits - Direct Operation of Vehicle by Biomass Fuels Like Wood Chips, Rice Husk and Alcohol	6 –
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	F.S.Seiler., " Alternate Energy Vehicle Information ", Publisher - Wind Book Inc (ISBN-13: 9780880160902),1997
2	Godfrey Boyle, "Renewable Energy", Publisher - Oxford University Press (ISBN-13: 9780199545339),2012
3	T. Nejat Veziroyqlu., " Alternative Energy Sources - III "Publisher - Hemisphere Publishing Co (ISBN-13: 9780891163350) , 1983

1. Subject Code: **AE418**   Course Title: **Supply Chain Management**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.) :   Theory: 3 Practical: 0

4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VIII

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   The main objective of supply chain management are to improve the overall organization performance and customer satisfaction by improving products or service delivery to customer. Supply chain management consists of all parties such as supplier, manufacturer, distributor, retailers, customers directly or indirectly involved in fulfilment of customers' demands.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction** : Perspective of Supply Chain Management,Managing uncertainty, Key issue in supply chainmanagement	6
2	**Inventory Management and Risk Pooling** : Inventorymanagement, Classification of inventory, Centralized versusDecentralized Warehousing and Risk pooling, Value ofInformation, Quantification of Bullwhip effect, Causes andremedies of Bullwhip effect	6
3	**Resource planning :** Aggregate Production Planning – Chase and leveling strategies, MRP, MRP-II, Agile manufacturingSystems	10
4	**Procurement and Outsourcing strategies** : Introduction, outsourcing benefits and risks, Make/Buy decision,e-procurement, Vendor selection and quota allocation	8
5	**Strategic Alliances** : Introduction, Third party logistics,Demand driven strategies, Distribution strategies directshipment, cross docking, transshipment, Supplierrelationships management, Customer relationship management	6
6	**International Issues in Supply Chain Management** Concepts in Globalization, Globalization forces, Risksand Advantages of International supply chains, Issuesin International supply chain management, Regional differences in logistics	6
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Designing and Managing the Supply Chain: concepts, strategic and case studies by David Simchi-Levi, Philip kaminsky, Edith Simchi-Levi, Ravi Shankar, Tata McGraw-Hill, ISBN: 978-0070666986
2	Supply Chain Management by Chopra and Mendle, PHI, ISBN:-13:978-0132743952
3	Supply Chain Management: Text and Cases by JannatSah, Pearson Education, ISBN-13:978-8131715178

1. Subject Code: **AE420**   Course Title: **Vehicle Safety Engineering**
2. Contact Hours   : L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0

4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VIII

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   To familiarize the students with the safety systems for automobiles, testing for safety, environment related testing and Motor vehicle Acts.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Automotive vehicle testing for Safety:** Introduction to active& passive vehicle safety systems	4
2	Braking test (as per IS 11852-2001), ABS performance &Traction control test Seat belt anchorage testing, Horn,lighting installation and mirror, test and their simulation	8
3	**Collapsible steering column testing :**Frontal crash test, sidedoor intrusion, interior and exterior test. Body block test (IS-11939-1996), Introduction to theoffset, Frontal impacttest (IS-11939-1996. & (ECE 94), Lateral Impact (ECE R95), AIS-029 : SURVIVAL SPACE FOR OCCUPANTS, pedestrianprotection test and other upcoming standards	8
4	**Environment related testing:** Emission test: As per TAP 115, Full throttle test for engine, pass by noise test and theirsimulation	8
5	**Performance:** gradability, Steering effort test, turning circlediameter test and their simulation**Controls:** speedometer calibration, MPFI, CRDI calibration test and their simulation	8
6	Motor Vehicle Act (1988), Central Motor Vehicles Rules(1989) and subsequent amendments	6
Total		**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Integrated Automotive Safety Handbook by U.W. Seiffert& M. Gonter Published by SAE-International ISBN (978- 07680-6437-7)

1. Subject Code: **AE422**   Course Title: **Packaging Technology**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.) :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   VIII
7. Subject Area   :   DEC
8. Pre-requisite   :   NIL
9. Objective   :   To familiarize the students with packaging as intregral process, packaging materials, testing standards and quality.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction :**Packaging as an integral process in production and marketing , Packages, Packaging characteristics, Physicalproperties. Mechanism of spoilage, degradation, corrosion& Their prevention. Compatibility-permissible plasticizersand their migration to food products. Package design	6
2	**Packaging Materials :**Papers and specialitypapers,cellulosic films and laminates. Plastic-PE, PP PS, PVC,PVDC,Nylon, Polyester and their combinations. Expanded PE,PSand bubble films. Glass containers, ampoules and vials.Composite containers, drums and paper tubes. Aluminumfoils, laminates and coating. Single layer and multilayer polymer packaging	8

3	**Ancillary materials :** Adhesives, Adhesive tapes. Cushioningmaterials and properties, reinforcements. Stitching methods.Seals and enclosures. Lining compounds and lacquers.Labels and instant labeling. Ink jet printing and bar coding.Graphic design. Printing techniques-Printing inks and printevaluations	8
4	**Testing, Standards and Quality control :** Mechaniclatesting, resistance to light, insect and mould. Barrier testing for air, oxygen etc., shelf life, worthiness of filled packages. Sealtests. Standards- basic concepts for rigid and non rigidand non rigid and ancillary materials standards for exportpackages, ISO 9000 and implications. Ecopackaging and regulatios	10
5	**Process machinery and equipment :** Machinery andequipment for manufacture of bottles, carry-bags andlaminates	10
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Daniel Lu,"Materials for Advanced Packaging", Publisher – Springer(ISBN-13: 9780387782188),2008
2	Brody " Encyclopedia of PackgingTechnolgy" ,Publisher - John Wiley
3	Piringer& Bauer "Plastics Packaging",publisher - , Wiley Interscience (ISBN-13: 9783527314553), 2008
4	Selke "Plastics Packaging",Publisher –Hanser(ISBN-13: 9781569903728),2004
5	Morris ,"Nano Packaging" ,publisher - Springer(ISBN:*9780387473253),2008*

1. Subject Code: **AE424**   Course Title: **Mechatronics**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   VIII

7. Subject Area   :   DEC
8. Pre-requisite   :   NIL
9. Objective   :   To familiarize the students with basic electronics concept, types of sensors and transducers, microprocessors and microcontrollers and mechatronic product design.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Basic Electronics & Computation:** Logic Gates, PassiveElectrical and Active Electronic Elements, Ic and Their Characteristics, Number System, Boolean Algebra, DigitalCircuit Technologies: Rtl/Dtl/Dctl/Ttl/ Mos/ Cmos/Ecl,Combinational and Sequential Circuits, Flip-Flops, Counters,Timers, Shift Registers. Memory System: Ram, Rom, Eprom,Eeprom, Pal, Plds, and gas	6
2	**Sensors andTransducers:** An Introduction to Sensors and Transducer, Classification, Static and Dynamic Characteristics,Sensors for Motion and Position, Force, Torque and TactileSensors, Flow Sensors, Temperature Sensing Devices,Range Sensors, Ultrasonic Sensors, Fiber Optic Devices inMechatronics. Actuators:-Hydraulic, Pneumatic and ElectricActuators.	6
3	**Microprocessor and Microcontroller:** 8085 Microprocessor Architecture and Its Operations-Memory-Input, Output Devices, Microprocessor Systems, Application in TemperatureControl & Traffic Control. Micro Controller Intel-8051, BasicFeatures, Application in Domestic Washing Machine	8
4	**System Modeling:** Mathematical Models, Building Blocks of Mechanical, Electrical, Fluid and Thermal System. Systems, Rotational-Translation Systems, Electromechanical Systems, Hydraulic-Mechanical Systems	8
5	**Signal Conditioning & Data Presentation System:** D and A Converters, Operational Amplifier; Protection, Filtering,Digital Signals, Multiplexers, Pulse Modulation, Data Acquisition, Digital Signal Processing; Pulse Modulation; DataPresentation Systems – Displays; Data Presentation Elements;Magnetic Recording; Data Acquisition Systems; Testing & Calibration, Interfacing Da and Ad Converters	8

6	**Mechatronic Product Design:** Traditional and Mechantronics Design Approach, Autotronics: Wind Screen Wiper Motion, Engine Management System, Digital Speedometer and Odometer, Automatic Dim and Bright Control, Engine Temperature Measurements, Radiator Water Level Indicator, Bath Room Scale, A Pick & Place Robot, Automatic Camera, & Bar Code Recorder. Introduction to Mems, Nems. Mechatronics Application in Bionics and Avionics	6
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	AppuuKuttan, K. K. ,"Introduction to Mechtronics",publisher : Oxford University Press(ISBN NO.9780195687811),2007
2	W. Bolton ,"Mechatronics" PublisheR: Addition Wesley (ISBN NO:9788131762578)
3	DevdasShetty and Richard A. Kolk Thomson Brooks/Cole ,"Mechatronics System Design" Publisher: C L Engineering(ISBN-13: 9781439061985), 1997
4	David G. Alciation and Michae-L B. Hist, "Introduction to Mechatronics and Measuring System"Publisher: Tata Mcgraw Hill(ISBN NO: 9780071163774),1999
5	Mahalik, N.P. "Mechatronics Principles, Concepts and Application", Publisher: Tata Mcgraw Hill(ISBN NO:0-70-048374-4),2006

1. Subject Code: **AE426**   Course Title: **Financial Management**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6. Semester   :   VIII

7. Subject Area   :   DEC

8. Pre-requisite   :   NIL

9. Objective   :   To introduce students with fundamentals of managing finances, various techniques used, planning of finance, cost accounting and financial analysis.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Fundamentals of Financial Management :**Introduction, Objectives, goals and functions of financial Management.Time value of Money, Risks and Returns, Valuation ofSecurities	6
2	**FINANCIAL INSTRUMENTS AND MARKETS :** Forms of Business Organizations, capital structure, Constructionanalysis and interpretation of standard financial statements,Dividend policy and share valuation	8
3	**Capital Budgeting :** Concept of Operating cycles and workingof Capital Management; Capital Budgeting : Cost of capitalinvestment decisions and Risk analysis in Capital Budgeting	8
4	**Financial Planning :** Planning of profit and leverages (operating and financial) Risk and Return: Nature of risk,Inter-relationship in risk and return, effect of Tax on return	6
5	**Cost Accounting :** Definition and scope of cost accountancy and costing methods, elements of cost overheadclassification distribution and absorption, process costing-Uniform, Marginal and standard costing methods, Casestudies	6
6	**Inflation and Financial Management :** Inflation and Asset revaluation, firm value, financial market returns, financialanalysis, capital budgeting	8
Total		**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Khan and Jain , "Financial Management", Publisher-TMH (ISBN: 978-0-07-065514-7)
2	I. M. Pandey , "Financial management" Publisher- Vikas Publishing House PVT. ltd (ISBN: 812591658X)

1. Subject Code: **AE428**   Course Title: **Fracture Mechanics**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   : 4
6. Semester   : VIII
7. Subject Area   : DEC
8. Pre-requisite   : NIL
9. Objective   : To familiarize the students with Mechanics of fracture, general yielding fracture mechanics, fracture safe design and fractured surfaces.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction:** Inter-disciplinary approaches in fracturemechanics, modes of deformation and failure	6
2	**Linear Elastic Fracture Mechanics:** Stress concentration inthe vicinity of notches and cracks, Griffith's energy concept,Irwin's stress intensity approach, fracture toughness	8
3	**General Yielding Fracture Mechanics:** Crack tip plasticzones, Wall's crack opening displacement concept, J-integral	6
4	**Evaluation of Fracture Mechanics Parameters:** Plane strainfracture toughness testing i.e., KIC	6
5	**Micro Structure and Fracture Toughness:** Physical significance of fracture toughness in relation tomicrostructure, principles for the development of fractureresistant materials	8
6	**Fracture Safe Design Principles:** Leak before break Paris Law for fatigue crack growth.**Fractured surfaces:** Acquaintance with some common fracture surfaces of various materials, like steels, C.I, non ferrous alloys etc	8
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Prashant Kumar; 'Elements of Fracture Mechanics"; Publisher- Tata McGraw- Hill Publishing Company Limited(ISBN 0070656967)
2	Knott.J.F; "Fundamentals of Fracture Mechanics", Publisher-John Wiley & Sons, Newyork(ISBN 0408705299)

3	Gdoutos.E.E; "Fracture Mechanics- An introduction"; Publisher-Springer (ISBN 9401581584)
4	Ramesh.K; "e-Book on Engineering Fracture Mechanics"; IIT Madras (ISBN: 978-81-904235-0-2)
5	T. L. Anderson , "Fracture Mechanics: Fundamentals and Applications", Publisher-CRC Press(ISBN 0849342600)
6	P. Kumar, "Elements of Fracture Mechanics", Publisher- Wheeler Publishing

1. Subject Code: **AE430**   Course Title: **Product Design and Development** (DEC-6,7,8)

2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS : 15   PRS : 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   VIII
7. Subject Area   :   DEC
8. Pre-requisite   :   NIL
9. Objective   :   To familiarize the students with the process of product design and development and to enhance critical thinking and prepare him in the field of product design and development. To familiarize him with concept of product design and development.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	Introduction: Classification/ Specifications of Products. Product life cycle. Product mix. Introduction to product design. Modern product development process. Innovative thinking. Morphology of design	6
2	Conceptual Design: Generation, selection & embodiment of concept. Product architecture. Industrial design: process, need. Robust Design: Taguchi Designs & DOE. Design Optimization	8
3	Design for Mfg & Assembly : Methods of designing for Mfg& Assy. Designs for Maintainability. Designs for Environment. Product costing.	6

	Legal factors and social issues. Engg ethics and issues of society related to design of products	
4	Value Engineering / Value Analysis. : Definition. Methodology. Case studies. Economic analysis: Qualitative & Quantitative	6
5	Ergonomics / Aesthetics: Gross human autonomy. Anthropometry. Man-Machine interaction. Concepts of size and texture, colour. Comfort criteria. Psychological & Physiological considerations. Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design, drawing, simulation, detail design	8
6	Concurrent Engg , Rapid prototyping , Tools for product design – Drafting / Modeling software. CAM Interface. Patents & IP Acts. Overview, Disclosure preparation	8
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	David G Ullman, "The Mechanical Design Process." Publisher- McGrawhillI ncSingapore (ISBN-13: 9780072975741) 1992 N J M Roozenberg , J Ekels , N F M Roozenberg "Product Design Fundamentals and Methods ."Publisher- John Willey & Sons (ISBN-13: 9780471954651) 1995
2	Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development." 1 / e 2004 , Publisher- Pearson Education New Delhi (ISBN-13: 9780130212719)
3	L D Miles "Value Engineering."Publisher- McGraw-Hill, 1972
4	Karl T Ulrich, Steven D Eppinger , " Product Design &Development."Publisher- Tata McGrawhill New Delhi (ISBN-13: 9780078029066)2003
5	Hollins B & Pugh S "Successful Product Design." Publisher- Butter worths London (ISBN 9780408038614)

1. Subject Code: **AE432**   Course Title: **Tractors and Farm Equipment and Off Road Vehicles**

2. Contact Hours   :   L: 3   T: 0   P: 2

3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0

4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0

5. Credits   :   4

6.	Semester	:	VIII
7.	Subject Area	:	DEC
8.	Pre-requisite	:	NIL
9.	Objective	:	This course introduces to general design of tractors, farm equipments; engine framework, off road vehicles and maintenance machines.

10. Details of Course :

S. No.	Contents	Contact Hours
1	**General Design of Tractors :**Classification of Tractors-Main Components of Tractor-Safety Rules. Control of the Tractorand Fundamentals of Engine Operation: Tractor Controlsand the Starting of the Tractor Engines-Basic Notionsand Definition-Engine Cycles-Operation of MulticylinderEngines-General Engine Design - Basic Engine PerformanceCharacteristics	8
2	**Engine Frame Work and Valve Mechanism of Tractor :** Cylinder and Pistons-Connecting Rods And CrankshaftsEngine Balancing –	10
	Construction and Operation of theValve Mechanism-Valve Mechanism Components – ValveMechanismTroubles.Cooling System, Lubrication System and Fuel System ofA Tractor: Cooling System – Classification – Liquid Cooling System – Components, Lubricating System Servicing and Troubles – Air Cleaner and Turbo Charger – Fuel Tanks and Filters –Fuel Pumps	
3	**Farm Equipments :** Working Attachment of Tractors-Farm Equipment – Classification – Auxiliary Equipment – Trailersand Body Tipping Mechanism	8
4	**Introduction of off Road Vehicles :**Classification of off Road Vehicles and their Application Excavator: Different Typesof Shovel and Dragline, Their Construction, Operating Principles, Operating Cycles . Production Capacity and sCost of Production Transport Equipment: Various Types of Dumpers, Main System, Components and Carrying Capacity of Dumper	8
5	**Road Making and Maintenance Machines :** Different Types of Dozer, Grader, and Their Construction. Operating Principles, Production Capacity and ApplicationMechanism.Other Equipment: Scraper and Front End Loader, TheirConstruction and OperationMaintenance: Maintenance Aspect of off Road Vehicles	8
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Abrosimov, K. Bran Berg, A and Katayer, K. Road Making Machinery, M I R. Publishers Moscow. 1971
2	De, A. Latest Development of Heavy Earth Moving Machinery, Annapurna Publishers, Dhanbad 1995
3	Nichols, Herber L (Jr.), Moving the Earth, Galgotia Publishing House, New Delhi, 1962
4	Rudnev, V. K. , Digging of Soils by Earthmover With Power Parts, Oxanian Press Pvt. Ltd., New Delhi
5	Rodichev and G.Rodicheva, Tractor and Automobiles, Mir Publishers, 1987
6	Kolchin. A., and V.Demidov Design of Automotive Engines for Tractor, Mir Publishers, 1972

1. Subject Code: **AE434**   Course Title: **Automobile Process Control**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.) :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 15   PRS: 25   MTE: 20   ETE: 40   PRE: 0
5. Credits   :   4
6. Semester   :   VIII
7. Subject Area   :   DEC
8. Pre-requisite   :   NIL
9. Objective   :   To understand various methods to control automotive processes, resource planning, operational performance, control system.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	Introduction: Classification/ Specifications of Products. Product life cycle. Product mix. Introduction to product design. Modern product development process. Innovative thinking. Morphology of design	8
2	**Resource planning :** Aggregate Production Planning – Chaseand leveling strategies, MRP, MRP-II, Agile manufacturingSystems	10

3	**OPERATIONAL PERFORMANCE** Engine performance & operating characteristics, Operation at full load and part load conditions, fuel economy, effect of vehicle condition, tyre and road condition, traffic condition and driving habits on fuel economy, vehicle safety.	8
4	**CONTROL SYSTEMS** Braking arrangements & Characteristics, weight transfer, steering arrangements, rigid & independent suspension, roll centre, torsion bar, stabilizer, radius bar.	8
5	**VEHICLE TRANSMISSION PERFORMANCE** Characteristics & features of friction clutches, mechanical gear transmission & Epicyclic gear boxes.	8
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Martyr A. J, Plint M. A, "Engine Testing Theory and Practice" 3 rdeditionPublisher-Butterworth-Heinemann, 2007(ISBN -13: 9780768018509)
2	Gousha H. M,"Engine Performance Diagnosis & Tune Up Shop Manual" Publisher-Canfield press (ISBN 9780064540032)
3	Giles J. G, "Vehicle Operation & Performance" Publisher-Iliffe, 1969
4	Crouse. W. H, Anglin. D. L, "Motor Vehicle Inspection", Publisher-McGraw Hill, (ISBN -13: 9780070148130)1978

Open Elective Courses

CO 351 ENTERPRISE & JAVA PROGRAMMING

1. Subject Code : **CO351** Course Title: **Enterprise & Java programming**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.): Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5. Credits : 3
6. Semester : ODD
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of Enterprise Java Programming, concepts of program development using beans.
10. Details of Course :

Unit No.	Contents	Contact Hours
1.	**Collections :** Collection Interfaces, Concrete Collections, Collections Framework. **Multithreading :** Creating and running thread, Multiple thread synchronization, Thread communication, Thread group, Thread priorities, Daemon Thread, Life Cycle of Thread.	5
2.	**Fundamentals in Networking:** Sockets in Java - Internet Addressing - DNS – Ipv4,IPv6- URL class - TCP/IP and Datagram. **The interfaces and classes for networking :**Interfaces and classes of java.net package; Inet Address class : IP address scope - Host name resolution - Methods of InetAddress class; Program to look up the IP addresses for a hostname - Factory methods - Creating and using Sockets : Socket class - constructors and methods of Socket class. **Creating TCP servers & clients :** TCP/IP server sockets - Constructors and methods of Server Socket class - Program to create a TCP/IP server and client. **Handling URL:** URL class - constructors and methods of URL class -URLConnection class - fields of URLConnection class - methods of URLConnection class. **Working with Datagrams:** Datagram Packet - Constructors for DatagramPacket class - Methods of Datagram Packet class - creating Datagram server and client.	6
3.	**JDBC Package :**JDBC – JDBC versus ODBC – Types of JDBC drivers – Connection – Statement – PreparedStatement.**ResultSet :**Fields of	6

	ResultSet – Methods of ResultSet – Executing a query - Result Set Meta Data – DatabaseMetaData. **Datatypes in JDBC :** Basic data types in JDBC – Advanced datatypes in JDBC – fields of Statement – methods of Statement – CallableStatement Interface – BatchUpdates	
4.	**Servlets :** Using Servlets - Servlet Package - Servlet lifecycle - init() method - service() method , doGet() method, doPost() method and destroy() method . **Classes and interfaces of Servlet:** Servlet - GenericServlet - ServletConfig - ServletContext - ServletException - ServletInputStream - ServletOutputStream - ServletRequest – Servlet Response. **Classes and interfaces of HttpServlet:** HttpServlet - HttpServletRequest - HttpServletResponse - Reading HTML form data from Servlets - Response Headers - Response Redirection. **Handling Servlets :** Servlet Chaining - HttpUtils - Database access with JDBC inside servlet. **State and Session management :** Cookies -Http Session - Server Side includes - Request forwarding – RequestDispatcher.	7
5.	**Concepts of Java Beans:** Java Beans - Advantage of Java Beans - Reflection and Introspection - Customizers – Persistence. **Developing Java Beans :** Bean Developer Kit (BDK) - Creating a Java Bean - Creating a Bean Manifest file - Creating a Bean JAR file. **Controls and Properties of a Bean :** Adding controls to Beans - Giving Bean Properties - BeanInfo interface - SimpleBeanInfo class. **Types of Properties:** Design pattern for Properties: Simple properties - Indexed Properties; Descriptor Classes - Giving Bean methods - Bound and Constrained Properties - Property Editors.	9
6.	**Components of EntrepriseBeans :** Distributed Multitiered Applications -J2EE components: J2EE clients, Web components, J2EE containers. **Developing an Enterprise Bean :** Packaging - Enterprise JavaBeans Technology - Enterprise Bean - Contents of an Enterprise Bean. **Session Bean :** Stateful session bean – life cycle of stateful session bean - Stateless session bean – life cycle of stateless session – ejbCreate methods – Business methods – Home interface – Remote interface – Running the session bean. **Entity Bean :**Persistence - Bean managed Persistence - Container Managed Persistance - Shared Access - Primary key – Relationships. **Message Driven Bean :**life cycle of message driven bean – on Message method.	9
	TOTAL	**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers
	Text Books
1.	Java 2 Programming Black Book - Steven Holzner dreamTech Press(ISBN-9788177226553), 2005
2.	JavaBeans Programming from the GroundUp - Joseph O'Neil, TMGH, New Delhi(ISBN- 007463786X), 2001
	Reference Books
3	Head first EJB-O'Reilly (ISBN: 8173665265), 2003
4.	"Beginning Java™ EE 6 Platform with GlassFish 3 From Novice to Professional" by Antonio Goncalves– Apress publication(ISBN: 9781430219545), 2009

CO353 E-COMMERCE AND ERP

1. Subject Code: **CO353**   Course Title: **E-Commerce and ERP**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE)(Hrs.) : Theory   3 Hrs   Practical 0
4. Relative Weightage   : CWS   25   PRS 0   MTE   25   ETE   50   PR 0
5. Credits   : 3
6. Semester   : ODD
7. Subject Area   : OEC
8. Pre-requisite   : Nil
9. Objective   : To introduce E-Commerce and ERP
10. Details of Course   :

Unit No.	Contents	Contact Hours
1.	Introduction: Definition of Electronic Commerce, E-Commerce: technology and prospects, incentives for engaging in electronic commerce, needs of E-Commerce, advantages and disadvantages, framework, Impact of E-commerce on business, E-Commerce Models.	7
2.	Network Infrastructure for E- Commerce: Internet and Intranet based E-commerce- Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband tele	7

	communication (ATM, ISDN, FRAME RELAY). Mobile Commerce: Introduction, Wireless ApplicationProtocol, WAP technology, Mobile Information device.	
3.	Web Security: Security Issues on web, Importance of Firewall, components of Firewall, Transaction security, Emerging client server, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls.	6
4.	Electronic Payments: Overview, The SET protocol, Payment Gateway, certificate, digital Tokens, Smart card, credit card, magnetic strip card, E-Checks, Credit/Debit card based EPS, online Banking. EDI Application in business, E- Commerce Law, Forms of Agreement, Govt. policies and Agenda.	
5.	ERP Introduction, Benefits, Origin, Evolution and Structure: Conceptual Model of ERP, The Evolution of ERP, The Structure of ERP. Business Process Reengineering, Data ware Housing, Data Mining, Online Analytic Processing(OLAP), Product Life Cycle Management(PLM),LAP, Supply chain Management.	8
6.	ERP Marketplace and Marketplace Dynamics:Market Overview, Marketplace Dynamics, The Changing ERP Market. ERP-Functional Modules: Introduction, Functional Modules of ERP Software, Integration of ERP, Supply chain and Customer Relationship Applications. ERP Implementation Basics, ERP Implementation Life Cycle, Role of SDLC/SSAD, Object Oriented Architecture, Consultants, Vendors and Employees, ERP & E-Commerce, Future Directives- in ERP, ERP and Internet.	8
	TOTAL	**42**

11. **Suggested Books**

S.No.	Name of Books / Authors/ Publishers
1.	Goel, Ritendra "E-commerce", New Age International,2007
2.	Ravi Kalakota, Andrew Winston, "Frontiers of Electronic Commerce", Addison-Wesley. 1996
3.	Vinod Kumar Garg and Venkitakrishnan N K, "Enterprise Resource Planning – Concepts and Practice", PHI 2004
4.	Rahul V. Altekar "Enterprise Resource Planning", Tata McGraw Hill, 2004
5.	Alexis Leon, "ERP Demystified", Tata McGraw Hill, 2014

CO355 CRYPTOGRAPHY AND INFORMATION SECURITY

1. Subject Code: **CO355**   Course Title: **Cryptography and Information Security**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE)(Hrs.) : Theory   3 Hrs   Practical 0
4. Relative Weightage   : CWS 25   PRS 0   MTE 25   ETE 50   PR 0
5. Credits   : 3
6. Semester   : ODD
7. Subject Area   : OEC
8. Pre-requisite   : NIL
9. Objective   : To study various cryptographic techniques, mathematics related to cryptography and some network security protocols.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1.	**Introduction:** Need for security, Introduction to security attacks, services and mechanism, introduction to cryptography, Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers, Intruders, Viruses and related threads.	6
2.	**Modern Block Ciphers:** Block ciphers principals, Shannon's theory of confusion and diffusion, Fiestal structure, data encryption standard (DES), strength of DES, crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, key distribution.	6
3.	Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primarily testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms, Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption	8
4.	**Message Authentication and Hash Function:** Authentication requirements, authentication functions, message authentication	6

	code (MAC), hash functions, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA), Public Key Infrastructure(PKI): Digital Certificate, private key management, Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.	
5.	**Authentication Applications:** Kerberos and X.509, directory authentication service, password, challenge-response, biometric authentication, electronic mail security-pretty good privacy (PGP), S/MIME.	8
6.	**IP Security:** Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. **Web Security:** Secure Socket Layer(SSL) and transport layer security, TSP, Secure Electronic Transaction (SET), Electronic money, WAP security, firewall design principals, Virtual Private Network (VPN) security.	8
	TOTAL	**42**

11.   **Suggested Books**

S.No.	Name of Books / Authors/ Publishers
1.	William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy. 2016
2.	Atul Kahate, "Cryptography and Network Security", TMH. 2009
3.	Behrouz A. Forouzan, "Cryptography and Network Security", TMH.2007
4.	Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag. 2004
5.	Bruce Schiener, "Applied Cryptography". 2015

CO357 OPERATING SYSTEM

1. Subject Code : **CO357**   Course Title : **Operating System**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE)(Hrs.) : Theory   3 Hrs   Practical 0
4. Relative Weightage   : CWS 25   PRS 0   MTE 25   ETE 50   PR   0
5. Credits   : 3
6. Semester   : ODD

7.	Subject Area	: OEC
8.	Pre-requisite	: NIL
9.	Objective	: To familiar with the fundamental principles of the operating system, its services and functionalities, the concepts of processes, synchronization and scheduling, memory management and need for protection in computer systems
10.	Details of Course	:

Unit No.	Contents	Contact Hours
1.	**Introduction:**Operating system and function, Evolution of operating system, Batch, Interactive, Time Sharing and Real Time System, System protection.**Operating System Structure:** System Components, System structure, Operating System Services.	4
2.	**Concurrent Processes:** Process concept, Principle of Concurrency, Producer Consumer Problem, Critical Section problem, Semaphores, Classical problems in Concurrency, Inter Process Communication, Process Generation, Process Scheduling.**CPU Scheduling:** Scheduling Concept, Performance Criteria of Scheduling Algorithm, Evolution, Multiprocessor Scheduling.	9
3.	**Deadlock:** System Model, Deadlock Characterization, Prevention, Avoidance and Detection, Recovery from deadlock combined approach.	8
4.	**Memory Management:** Base machine, Resident monitor, Multiprogramming with fixed partition, Multiprogramming with variable partition, Multiple base register, Paging, Segmentation, Virtual memory concept, Demand paging, Performance, Paged replacement algorithms, Allocation of frames, Thrashing, Cache memory organization, Impact on performance.	9
5.	**I/O Management & Disk Scheduling:** I/O devices and organization of I/O function, I/O Buffering, DISK I/O, Operating System Design Issues. **File System:** File Concept, File Organization and Access Mechanism, File Directories, File Sharing, Implementation Issues	9
6.	**Case Studies:** Windows, Linux and Unix	3
TOTAL		**42**

11. **Suggested Books**

S.No.	Name of Books / Authors/ Publishers
	Text Books
1.	Silbersachatz and Galvin, "Operating System Concepts", Pearson, 5th Ed, 2001
2.	Tannenbaum, "Operating Systems", PHI, 4th Edition, 2000
	Reference Books
3.	Milenekovic, "Operating System Concepts", McGraw Hill 2001
4.	Dietel, "An introduction to operating system", Addison Wesley 1983

CO359 INTELLECTUAL PROPERTY RIGHTS

1. Subject Code: **CO359**   Course Title: **Intellectual Property Rights**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3Hrs   Practical 0
4. Relative Weightage   : CWS 25   PRS 0   MTE 25   ETE 50   PR 0
5. Credits   : 3
6. Semester   : ODD
7. Subject Area   : OEC
8. Pre-requisite   : Nil
9. Objective   : To familiarize the students with basic concepts in each type of IPR together with historical developments in the subject & its importance in modern times.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1.	Introduction: Concept of IPR, Historical development , kinds of IPR, brief description of patent, trademark, copyright ,industrial design, importance of IPR, IPR authorities.	5
2.	PATENTS :Introduction, Indian Patent Act 1970 &2002, Protectable subject matter—patentable invention, Procedure for obtaining patent, Provisional and complete specification Rights conferred on a patentee, transfer of patent, Revocation and surrender of patents, Infringement of	8

	patents, Action for infringement, Patent agents, Patent in computer programs.	
3.	Trademark: Introduction, Statutory authorities, principles of registration of trademarks, rights conferred by registration of trademarks, Infringement of trademarks and action against infringement, procedure of registration and duration,licensing in trademark	7
4.	Copyright: Introduction, Author and ownership of copyright, rights conferred by copyright,term of copyright, assignment/licence of copyright, Infringement of copyright ,remedies against infringement of copyright, registration of copyright, copyright enforcement and societies	7
5.	Industrial design: The design act-2000, registerability of a design, procedure of registration of a design, piracy of a registered design, Case law on designs	6
6.	International IPR & case laws: World intellectual property organization, WCT, WPPT, TRIPS, Copyright societies, international IPR dispute resolution mechanism. Case laws.	9
	TOTAL	**42**

11. **Suggested Books**

S.No.	Name of Books / Authors/ Publishers
	Textbooks:
1.	Law Relating to Intellectual property, fourth edition by B.L.Wadehra .Universal law publishing co. pvt. Ltd , 2007. ISBN 978-81-7534-588-1
	Reference books:
2.	Intellectual property: Patents, copyright ,trademarks and allied rights. Fifth edition by W.R. Cornish. Sweet & Maxwell publisher, 2003. ISSN 9780421781207
3	Law and practice of intellectual property in India by VikasVashishth, 2006**ISBN:** 81-7737-119-3
4	Patents ,copyrights, trade marks and design by B L Wadhera, 2014
5	Dr. B. L. Wadhera, "Intellectual Property Law Handbook". Universal Law Publishing, 2002.

CO361 DATABASE MANAGEMENT SYSTEM

1. Subject Code : **CO361**   Course Title : **Database Management System**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE)(Hrs.): Theory   3 Hrs   Practical 0
4. Relative Weightage   : CWS   25   PRS 0   MTE   25   ETE 50   PR 0
5. Credits   : 3
6. Semester   : ODD
7. Subject Area   : OEC
8. Pre-requisite   : NIL
9. Objective   : To provide knowledge about the principles, concepts and applications of Database Management System.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1.	**Introduction:** Data base system concepts and its architecture, Data models schema and instances, Data independence and data base language and interface, Data definition languages, DML. Overall data base structure. **Data modeling using Entity Relationship Model:** E.R. model concept, notation for ER diagrams mapping constraints, Keys, Concept of super key, candidate key, primary key generalizations, Aggregation, reducing ER diagrams to tables, extended ER model.	7
2.	**Relational Data Model and Language:** Relational data model concepts, integrity constraints, Keys domain constraints, referential integrity, assertions, triggers, foreign key relational algebra, relational calculus, domain and tuple calculus, SQL data definition queries and updates in SQL.	7
3.	**Data Base Design:** Functional dependencies, normal forms, 1NF, 2NF, 3NF and BCNF, multi-valued dependencies fourth normal forms, join dependencies and fifth normal forms. Inclusion dependencies, loss less join decompositions, normalization using FD, MVD and JDs, alternatives approaches to database design.	6
4.	**File Organization, Indexing and Hashing** Overview of file organization techniques,Indexing and Hashing- Basic concepts, Static Hashing, Dynamic Hashing, Ordered indices, Multi-level indexes, B-Tree index files, B+- Tree index files, Buffer	8

	management**Transaction processing concepts:** Transaction processing system, schedule and recoverability, Testing of serializability, Serializability of schedules, conflict & view serializable schedule, recovery from transaction failures, deadlock handling.	
5.	**Concurrency Control Techniques:** Locking Techniques for concurrency control, time stamping protocols for concurrency control, concurrency control in distributed systems. multiple granularities and multi-version schemes.	8
6	**Case Studies:** Commercial databases, Oracle, Postgress, MySQL	6
	TOTAL	**42**

11.   **Suggested Books**

S.No.	Name of Books / Authors/ Publishers/Text Books
1	Elmasri, Navathe,"Fundamentals of Database systems", Addision Wesley, 2016
2	Korth, Silberchatz, Sudarshan,"Data base concepts", McGraw-Hill. 2010
	Reference Books
1.	Ramakrishna, Gehkre, "Database Management System", McGraw-Hill 2014
2.	Date C.J., "An Introduction to Database systems" 2006

EC351 MECHATRONICS

1. Subject Code: **EC351**   Course Title : **Mechatronics**
2. Contact Hours   : L: 3   T: 1   P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs   Practical 0
4. Relative Weightage   : CWS 25   PRS 0   MTE 25   ETE   50   PR   0
5. Credits   : 4
6. Semester   : V
7. Subject Area   : OEC
8. Pre-requisite   : Nil
9. Objective: To introduce fundamentals of Mechatronics
10. Details of Course   :

Unit No.	Contents	Contact Hours
1.	Introduction : Basic Definitions and key elements of Mechatronics, Mechatronic Design Approach: Functions of Mechatronic Systems, Ways of Integration, Information Processing Systems (Basic Architecture and hardware and Software trade-offs, Concurrent Design Procedure for Mechatronic Systems	6
2.	System Interfacing, Instrumentation,and Control Systems: Input and output Signals of a Mechatronic System, Signal Conditioning and microprocessor control, Microprocessor-Based Controllers and Microelectronics, Programmable Logic Controllers	6
3.	Introduction to Micro- and Nanotechnology, Micro-actuators, Micro-sensors, Nanomachines. Modeling Electromechanical Systems: Models for Electromechanical Systems, Rigid Body Models, Basic Equations of Dynamics of Rigid Bodies, Simple Dynamic Models, Elastic System Modeling, Dynamic Principles for Electric and Magnetic Circuits, Earnshaw's Theorem and Electromechanical Stability	10
4.	The Physical Basis of Analogies in Physical System Models: The Force-Current Analogy: Across and Through Variables, Maxwell's Force-Voltage Analogy:Effort and Flow Variables, A Thermodynamic Basis for Analogies	6
5.	Introduction to Sensors and Actuators: Characteristics of Sensor and Actuator Time and Frequency Measurement, The Role of Controls an modelling in Mechatronics: Integrated Modeling, Design, and Control Implementation, Special Requirements of Mechatronics that Differentiate from Classic Systems and Control Design, Modeling as Part of the Design Process, Modeling of Systems and Signals	6
6.	Design Optimizationof Mechatronic Systems: Optimization Methods, Principles of Optimization : ParametricOptimization, General Aspects of the OptimizationProcess, Types of Optimization Methods, Selection of aSuitable Optimization Method, Optimum Design of Induction Motor (IM), IM Design Introduction : Classical IM Design, Use of a Neuron Network for the Identification ofthe Parameters of a Mechanical dynamic system, Mechatronics and Computer Modelingand Simulation, Mechatronics and the Real-Time useof Computers, Communications andComputer Networks,Control withEmbedded Computersand ProgrammableLogic Controllers	8
	TOTAL	**42**

11. **Suggested Books**

S.No.	Name of Books / Authors/ Publishers
1.	Mechatronics : an introduction by Robert H Bishop, Taylor & Francis, 2005
2.	Introduction to Mechatronics by KK AppuKuttan Oxford University Press, 2007
	EC353 COMPUTER VISION

1. Subject Code : **EC-353**   Course Title : **Computer Vision**
2. Contact Hours   :L : 3   T : 1   P : 0
3. Examination Duration (ETE)(Hrs.):Theory   3 Hrs   Practical 0
4. Relative Weightage   : CWS 25   PRS -   MTE 25   ETE 50   PR   0
5. Credits   : 4
6. Semester   : V
7. Subject Area   : OEC
8. Pre-requisite   : Nil
9. Objective   : To introduce fundamentals of Computer Vision and algorithms for object detection, recognition and tracking.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1.	Introduction to computer vision: Role of Artificial intelligence and image processing in Computer Vision, Industrial Machine Vision applications, System architecture. Visual Sensors: Camera sensors: RGB, IR, Kinect sensor, Camera interfaces and video standards, Characteristics of camera sensors commercially available cameras. Camera Calibration: Interior, exterior calibration and rectification using Tsai's Calibration method.	5
2.	Basics of image processing - Pixel representations histograms, transforms, colour filters, noise removal, Geometry: Math methods - linear algebra, vectors, rotations, Stereo - Epi-polar geometry, correspondence, triangulation ,Disparity maps . Basics of video processing - Background subtraction techniques - frame differencing, Gaussian Mixture Modelling (GMM), Object localization and processing:- Contours, edges, lines, skeletons.	7

3.	Image representation: Local Wavelet basis (multiscale), Global Fourier basis(Frequency), Adaptive basis (PCA and ICA) , Adaptive basis (discriminants) Basics of Object detection - Template matching, Cascade classifiers.	8
4.	Object Recognition : Object Modeling, Bayesian Classification, Feature Selection and Boosting, Scene and Object Discrimination.	6
5.	Motion and Tracking: Motion detection and tracking of point features, optical flow, SURF, SIFT. Tracking- Kalman filter, Particle Filter, Comparison of deterministic and probabilistic methods condensation, tracking humans, multi-frame reconstruction under affine and perspective projection geometry.	8
6.	Introduction to Computer Vision programming libraries: MATLAB/ OpenCV. advantages and disadvantages of each .	8
	TOTAL	**42**

11.   **Suggested Books**

S.No.	Name of Books / Authors/ Publishers
1.	Computer Vision: A Modern Approach (2nd Edition) 2nd Edition by David A. Forsyth (Author), Jean Ponce (Author), 2002
2.	Learning OpenCV: Computer Vision with the OpenCVLibrary Gary Bradski, Adrian Kaehler, 2008

EC355 EMBEDDED SYSTEM

1. Subject Code : **EC- 355**   Course Title : **Embedded Systems**

2. Contact Hours   : L: 3   T: 1   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs   Practical   0

4. Relative Weightage   : CWS 25 PRS 0 MTE   25 ETE 50 PR   0

5. Credits   : 4

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Knowledge of Computer Architecture and Microprocessors

9. Objective   : To introduce fundamentals of 16 and 32 bit Microcontrollers, assembly language programming. The course also focuses on interfacing of different interrupt

driven peripherals. It also covers in detail Real Time Operating Systems, Bus architecture, Digital Signal Processors and System On-Chip.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Overview of Embedded Systems: Characteristics of Embedded Systems. Comparison of Embedded Systems with general purpose processors. General architecture and functioning of micro controllers. PIC and 8051 micro controllers : Architecture, memory interfacing , interrupts, instructions, programming and peripherals .	8
2.	ARM : Architecture, memory interfacing , interrupts, instructions and Assembly Language programming. Exception processing and pipeline architecture and applications.	12
3.	Digital Signal Processors: DSP Architecture, DSP applications, algorithms, data path, memory, addressing modes, peripherals. TI and Sharc family of DSP processors.	4
4.	System On Chip : Evolution, features, IP based design, TI OMAP architecture and peripherals. Digital Multimedia processor: Architecture and peripherals.	4
5.	SRAM, DRAM working and organization. Interfacing memory with ARM 7. Elements of Network Embedded Systems	4
6.	RTOS : RT-Linux introduction, RTOS kernel, Real-Time Scheduling Bus structure: Time multiplexing, serial, parallel communication bus structure. Bus arbitration, DMA, PCI, AMBA, I2C and SPI Buses.	10
	TOTAL	**42**

11.   **Suggested Books**

S.No.	Name of Books / Authors/ Publishers
1.	Computers as components: Principles of Embedded Computing System Design, Wayne Wolf, Morgan Kaufman Publication, 2000
2.	ARM System Developer's Guide: Designing and Optimizing System Software, Andrew N. Sloss, Dominic Symes, Chris Wright, , Morgan Kaufman Publication, 2004

3.	Design with PIC Microcontrollers, John B. Peatman, Pearson Education Asia, 2002
4.	The Design of Small-Scale embedded systems, Tim Wilmshurst, Palgrav, 2003
5.	Embedded System Design, Marwedel, Peter, Kluwer Publishers, 2004

EC357 DIGITAL IMAGE PROCESSING

1. Subject Code : **EC 357**   Course Title : **Digital Image Processing**
2. Contact Hours: : L : 3   T: 1   P: 0
3. Examination Duration (ETE) (Hrs.): Theory 3Hrs   Practical 0
4. Relative Weightage   : CWS 25 PRS 0 MTE 25 ETE 50 PR   0
5. Credits   : 4
6. Semester   : V
7. Subject Area   : OEC
8. Pre-requisite   : Signals and Systems
9. Objective   : To introduce the fundamentals of visual information, representation of 2-D and 3-D information, enhancement of information, retrieval of information, and various colour models.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1.	Introduction to Image processing, fundamental steps in DIP, concept of visual information, image formation model, image sampling and quantization, digital image representation, spatial and gray level resolution, relationship between pixels, application of image processing system.	6
2.	Introduction to Multidimensional signals and systems, 2D-Signals, 2D systems, classification of 2D system, 2D convolution, 2D Z transform, Image Transform: 2D-DFT, discrete cosine, discrete sine, Haar, Walsh, Hadamard, Slant, KL, SVD, Hough, Radon, Ridgelet.	8
3.	Image enhancement; Spatial domain: linear transformation, image negative, grey level shifting, non-linear transformation, logarithmic transformation, exponential transformation, grey level slicing, bit plane slicing, image averaging, mask processing, histogram manipulations, histogram thresholding, histogram stretching, histogram equalization,	10

	noise removing filters, smoothing filters, sharpening filters. Enhancement in Frequency Domain; ideal low pas filter, Butterworth low pass filter, ideal high pass filters, Butterworth high pass filter, band pass filter, Gaussian filters, Homomorphic filtering.	
4.	Image restoration: degradation model, noise models, restoration in presence of noise, periodic noise removal in frequency domain, notch filters, inverse filtering, Wiener filtering.	6
5.	Introduction to Morphological Image Processing operations, dilation and erosion, opening and closing, hit-or-miss transformation, boundary extraction, region filling, extraction connected components, convex hull, thinning, thickening, skeletons, pruning.	6
6.	Introduction to various colour models: RGB, CMY, CMYK, HSI, HSV, and YCbCr. Concept of image compression, Image Segmentation: detection of discontinuities, edge linking and boundary detection, thresholding, region based segmentation, use of motion in segmentation.	6
	TOTAL	**42**

11.   **Suggested Books**

S.No.	Name of Books / Authors/ Publishers
1.	Digital Image Processing/ Gonzalez and Woods/ Pearson Education, 2008/Third Edition
2.	Fundamentals of Digital Image Processing/ A.K. Jain/ PHI, Indian Edition
3.	Digital Image Processing using MATLAB/ Gonzalez, Woods, and Eddins/ McGraw Hill, Second/ 2013
4.	Digital Image Processing/ K.R. Castleman/ Pearson, 2014
5.	Digital Image Processing Algorithms and Applications/I. Pitas/John Wiley, 2002
6.	Image Processing, Analysis, and Machine Vision/Milan Sonka, Vaclav Hlavac, Roger Boyale/ Cengage Learning, 4th Edition

EC359 VLSI DESIGN

1. Subject Code : **EC -359**   Course Title: **VLSI Design**

2. Contact Hours   : L: 3   T: 1   P: 0

3. Examination Duration (ETE) (Hrs.): Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25   PRS 0   MTE 25   ETE 50   PR 0

5. Credits   : 4

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : To give the student an understanding of the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design in silicon.

10. Details of Course

Unit . No.	Contents	Contact Hours
1.	Introduction to VLSI, Manufacturing process of CMOS integrated circuits, CMOS n-well process design rules, packaging integrated circuits, trends in process technology.MOS transistor, Energy band diagram of MOS system,MOS under external bias, derivation of threshold voltage equation, secondary effects in MOSFETS	6
2.	MOSFET scaling and small geometry effects, MOScapacitances, Modeling of MOS transistors using SPICE, level I II and equations, capacitance models.The Wire: Interconnect parameters: capacitance, resistance and inductance.Electrical wire models: The ideal wire, the lumpedmodel, the lumped RC model, the distributed RC model, the transmission line model, SPICE wire models.	6
3.	MOS inverters: Resistive load inverter, inverter with n-type MOSFET load, CMOS inverter: Switching Threshold, Noise Margin, Dynamic behavior of CMOS inverter, computing capacitances, propagation delay, Dynamic power consumption, static power consumption, energy, and energy delay product calculations, stick diagram, IC layout design and tools.	8
4.	Designing Combinational Logic Gates in MOS and CMOS:MOS logic circuits with depletion MOS load.Static CMOS Design: Complementary CMOS, Ratioedlogic, Pass transistor logic, BiCMOS logic, pseudo nMOS logic,Dynamic CMOS logic, clocked CMOS logic CMOS domino logic, NP domino logic, speed and power dissipation of Dynamic logic, cascading dynamic gates.	8

5.	Designing sequential logic circuits: Timing matrices for sequential circuits, classification of memory elements, static latches and registers, the bistability principle, multiplexer based latches, Master slave Edge triggered register, static SR flip flops, dynamic latches and registers, dynamic transmission gate edge triggered register, the C2MOS register	8
6.	Pulse registers, sense amplifier based registers, Pipelining, Latch verses Register based pipelines, NORA-CMOS. Two-phase logic structure; VLSI designing methodology –Introduction, VLSI designs flow, Computer aided design technology: Design capture and verification tools, Design Hierarchy Concept of regularity, Modularity & Locality, VLSI design style, Design quality.	6
	TOTAL	**42**

11. **Suggested Books**

S.No.	Name of Books / Authors/ Publishers
1.	Digital integrated circuits a design perspective byJan M Rabaey, Anantha Chadrakasan Borivoje Nikolic, Pearson education, 2011.
2.	CMOS digital integrated circuits by Sung MO KangYusuf Leblebici, Tata McGraw Hill Publication, 2002
3.	Principle of CMOS VLSI Design by Neil E Weste and Kamran Eshraghian, Pearson education, 2000.

EE351 POWER ELECTRONIC SYSTEMS

1. Subject Code: **EE-351**   Course Title: **Power Electronic Systems**

2. Contact Hours   : L: 3 T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory : 3   Practical: 0

4. Relative Weight   : CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : VIII

7. Subject Area   : OEC

8. Pre-requisite   : EE-203, EE-301

9. Objective   : To familiarize the students with power electronics and its applications.

10. Details of Course   :

Unit No.	Contents	Contact Hours
1.	Solid State Power Devices: Principle of operation of SCR, dynamic characteristic of SCR during turn ON and turn OFF, parameters of SCR, dv/dt and di/dt protection, snubber circuit, commutation circuits; Principle of operation ofMOSFET, IGBT, GTO, MCT, SIT, SITH, IGCT, their operating characteristics.	8
2.	Single-phase Converter: Half wave converter, 2-pulse midpoint converter, half controlled and fully controlled bridge converters, input current and output voltage waveforms, effect of load and source impedance, expressions for input power factor, displacement factor, harmonic factor and output voltage, effect of free-wheeling diode, triggering circuits.Three-phase Converter: Half wave, full wave, half controlled and fully controlled bridge converters, effect of load and source impedance, expressions for input power factor, displacement factor, harmonic factor and output voltage,	8
3.	AC-AC Converters: Principle of operation of cycloconverter, waveforms, control technique; Introduction of matrix converter.	4
4.	DC-DC Converters: Principle of operation of single quadrant chopper, continuous and discontinuous modes of operation; Voltage and current commutation, design of commutating components; Introduction to SMPS.	4
5.	Inverters: Voltage source and current source inverters, Principle of operation of single-phase half bridge and full bridge voltage source inverters, voltage and current waveforms; Three-phase bridge inverter, 120^0 and 180^0 modes of operation, voltage and current waveforms with star and delta connected RL load; Voltage and frequency control of inverters; PWM techniques-single pulse, multiple pulse, selective harmonic elimination, sinusoidal PWM.	8
6.	Applications:FACTS Technology: Reactive power control in power systems, transmission system compensation, static series and shunt compensation, static shunt and series compensators- SVC, STATCOM, TCSC, SSSC and their working principles and characteristics. Combined series-shunt compensators –UPFC and its applications and characteristic.VSC-HVDC Systems: Principles and applications	10
Total		**42**

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11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1.	Mohan N., Undeland T. M. and Robbins W. P., "Power Electronics-Converters, Applications and Design", 3rd Ed., Wiley India, 2002.
2.	Rashid M. H., "Power Electronics Circuits Devices and Applications", 3rd Ed., Pearson Education, 2004.
3.	N.G. Hingorani and L. Gyugyi, "Understanding FACTS", IEEE Press, 2000
4.	K.R. Padiyar, "Facts Controllers In Power Transmission and Distribution", New Age publishers, 2013
5.	HVDC power transmission system, K.R.Padiyar, NewAge Publishers,2011

EE353 ELECTRICAL MACHINES AND POWER SYSTEMS

1. Subject Code: **EE-353**   Course Title: **Electrical Machines and Power Systems**
2. Contact Hours   :   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3   Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   3
6. Semester   :   VIII
7. Subject Area   :   OEC
8. Pre-requisite   :   EE-208, EE-303, EE-304
9. Objective   :   To familiarize the students with electrical machines and power systems.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1	Transformers : constructional features, types, Special constructional features – cruciform and multiple stepped cores, cooling methodology, conservators, breather, Buchholz relay, voltage, current and impedance relationships, equivalent circuits andphasor diagrams at no load and full load conditions,voltage regulation, losses and efficiency, all day efficiency, auto transformer and equivalent circuit, parallel operation and load sharing.	8

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2	Asynchronous machines: General constructional features of poly phase asynchronous motors, concept of rotating magnetic field, principle of operation, phasor diagram, Equivalent circuit, torque and power equations, torque-slip characteristics, losses and efficiency.	8
3	Synchronous machines : General constructional features, armature winding, emf equation, effect of distribution and pitch factor,flux and mmf relationship, phasor diagram, non-salient pole machine, equivalent circuit, determination of equivalent circuit parameters by open and short circuit tests, voltage regulation using synchronous impedance method, power angle characteristics	9
4	Single line diagram of power system, brief description of power system elements, synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator. Supply System:different kinds of supply system and their comparison, choice of transmission voltage. Transmission Lines:configurations, types of conductors, resistance of line, skin effect	9
5	Transmission lines: Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit ,transmission lines, representation and performance of short, medium and long transmission lines, Ferranti effect,surge impedance loading.	8
Total		**42**

11.   **Suggested Books**

S. No.	Name of Authors /Books / Publishers
1	Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, 'Electric Machinery', Tata McGraw Hill, 2006.
2	M.G. Say, 'Performance and Design of Alternating Current Machines', CBS Publishers, New Delhi, 2008
3	Nagrath I. J and Kothari D.P. 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2010.
4	Power System Analysis, J. Grainger and W.D. Stevenson, TMH, 2006.
5	Electrical Power Systems,C. L.Wadhwa, New age international Ltd. Third Edition, 2010
6	Electric Power Generation, Transmission&Distribution,S.N.Singh, PHI Learning, 2008.

EE-355 INSTRUMENTATION SYSTEMS

1. Subject Code: **EE-355**   Course Title: **Instrumentation Systems**
2. Contact Hours   :   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3   Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   3
6. Semester   :   VIII
7. Subject Area   :   OEC
8. Pre-requisite   :   EE-203, EE-313
9. Objective   :   To familiarize the students with instrumentation systems.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1	Transducers-I:Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, strain gauges, resistance thermometer, thermistors, thermocouples, LVDT, RVDT	8
2	Transducers-II:Capacitive, piezoelectric, Hall effect and opto electronic transducers. measurement of motion, force, pressure, temperature flow and liquid level.	8
3	Telemetry:General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data Acquisition System:A/D and D/A converters, analog data acquisition system, digital data acquisition system, modern digital data acquisition system and signal conditioning.	8
4	Display Devices and RecordersDisplay devices, storage oscilloscope, DSO, spectrum analyzer, digital recorders.RecentDevelopments: Introduction to virtual and intelligent instrumentation, fibre optic transducers, smart sensors, smart transmitters, process instrumentation diagrams.	8
5	Programmable Logic Controllers :Evolution of PLC-sequential and programmable controllers, architecture and programming of PLC, relay logic and ladder logic, functional blocks, communication networks for PLC, field bus, profi-bus, mod-bus	10
Total		**42**

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11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Electronic Instrumentation and Measurement Techniques, W.D. Cooper and A.D. Helfrick, Prentice Hall International,2009.
2	Measurement Systems Application and Design Ernest Doebelin, McGraw- Hill Higher Education, 5th edition , 2003
3	Instrumentation, Measurement and Analysis, B.C. Nakra& K. Chaudhry, Tata McGraw Hill, 2nd Edition, 2001.
4	Advanced Measurements and Instrumentation, A.K. Sawhney, DhanpatRai& Sons, 2010
5	Process Control Instrumentation Technology, Curtis D. Johnson, Pearson, 6th edition, 1999
6	Programmable Logic Controllers, Frank D. Petruzella McGraw-Hill Higher Education, 4th edition, 2010

EE357 UTILIZATION OF ELECTRICAL ENERGY

1. Subject Code: **EE-357**   Course Title: **Utilization of Electrical Energy**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (Hrs.) : Theory: 3   Practical: 0
4. Relative Weight   : CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   : 3
6. Semester   : VIII
7. Subject Area   : OEC
8. Pre-requisite   : EE-208, EE-303
9. Objective   : To familiarize the students with the concept of electrical power, energy and its utilization.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1.	Illumination: Definition:- Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux. Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light, Review of laws of illumination, Different	10

	types of lighting sources and their use in domestic, street and industrial lighting, Energy considerations. LED's and their driving circuits.	
2	Electric Heating : Advantages of electrical heating, Heating methods: Resistance heating – direct and indirect resistance heating, properties of resistance heating elements, Induction heating; principle of core type and coreless induction furnace, Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace, Dielectric heating, applications in various industrial fields, Infra-red heating and its applications, Microwave heating	08
3.	Electric Welding: Introduction to electric welding, Welding methods, Principles of resistance welding, types – spot, projection seam and butt welding and welding equipment used, Principle of arc production, electric arc welding, characteristics of arc, Design of Power supply and welding control circuit, comparison between AC and DC arc welding, welding control.	08
4.	Electrolytic Processes: Need of electro-deposition laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing, buffing equipment and accessories for electroplating factors affecting electro-deposition , principle of galvanizing and its applications, anodising and its applications, electroplating on non-conducting materials, manufacture of chemicals by electrolytic process, electrolysis for water purification	08
5.	Refrigeration and Air Conditioning and Water Coolers: Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants, description of electrical circuit used in a) refrigerator, b) air-conditioner, and c) water cooler, variable speed drive for compressors, high speed compressors, insta-chill, Peltier effect, thermoelectric cooling, sterling engines, solar concentrator heating and cooling,	08
Total		**42**

11.   **Suggested books:**

S. No.	Name of Authors /Books / Publishers
1.	Dubey G. K., "Fundamentals of Electric Drives", 2nd Ed., Narosa Publishing House,2007.
2.	Taylor E. O., "Utilization of Electric Energy (in SI units)", Orient Longman, Revised in S.I. units by Rao, V.V.L,1999
3.	Hancock N. N., "Electric Power Utilisation", Wheelers,1979.

EE-359 NON-CONVENTIONAL ENERGY SYSTEMS

1. Subject Code: **EE-359**   Course Title: **Non-conventional Energy Systems**
2. Contact Hours   :   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3   Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   3
6. Semester   :   VIII
7. Subject Area   :   OEC
8. Pre-requisite   :   EE-301, EE-303
9. Objective   :   To familiarize the students with the non-conventional
                                       sources of energy and their integration to the grid.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1	Introduction to Non Conventional Energy SystemsVarious non-conventional energy resources Introduction, availability, classification, relative merits and demerits. Solar Cells: theory of solar cells, solar cell materials, solar cell array, solar cell power plant, limitations. Solar Thermal Energy: solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance, solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.	10
2	Geothermal EnergyResources of geothermal energy, thermodynamics of geo-thermal energy conversion, electrical conversion, non-electrical conversion,environmental considerations. Magneto-hydrodynamics (MHD):principle of working of MHD power plant, performance and limitations.	8
3	Fuel Cells: Basic principle of working, various types of fuel cells, performance and limitations.	8
4	Thermo-electrical and thermionic conversionsPrinciple of working of thermo-electrical and thermionic conversions, performance and limitations. Wind energy: wind power and its sources, site selection criteria, momentum theory, classification of rotors, concentrations and augments, wind characteristics, performance and limitations of wind energy conversion systems.	8

5	Energy from Bio-mass, Ocean Thermal, Wave and bio-waste Availability of bio-mass and its conversion principles, ocean thermal energy conversion principles, performance and limitations, wave and tidal energy conversion principles, performance and limitations, bio-waste recycling power plants.	8
	Total	**42**

11.   **Suggested books:**

S. No.	Name of Authors /Books / Publishers
1	Renewable Energy Resources, John Twidell, Tony Weir, Taylor and Francis, 2nd edition,2005.
2	Solar Engineering of Thermal Processes,John A. Duffie, William A. Beckman, John Wiley & Sons, 4th edition,2013.
3	Biofuels, Solar and Wind as Renewable Energy Systems: Benefits and Risks,D. Pimentel, Springer,1st edition,2010.
4	Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers,Chetan Singh Solanki, PHI Learning,2013.
5	Non Conventional Energy Resources, D.S. Chauhan, New Age International Pvt Ltd.,2006

EE-361 EMBEDDED SYSTEMS

1. Subject Code : **EE-361**   Course Title: **Embedded Systems**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0
4. Relative Weight   : CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   : 3
6. Semester   : VIII
7. Subject Area   : OEC
8. Pre-requisite   : EE-306, EE-427
9. Objective   : To familiarize the students with the concepts of embedded systems.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1.	Embedded Processing – Evolution, Issues and Challenges;	1
2	System and Processor Architecture : von Neumann, Harvard and their variants	2
3	Memory Architecture and Devices; Input-Output Devices and Mechanisms	5
4	Instruction Set and Addressing Modes, Interfacing of Memory and Peripheral Devices – Functional and Timing Issues	6
5	Application Specific Logic Design using Field Programmable Devices and ASICs	2
6	Analog to Digital and Digital to Analog Converters	2
7	Bus I/O and Networking Considerations, Bus and Wireless Protocols	4
8	Embedded Systems Software : Constraints and Performance Targets	2
9	Real-time Operating Systems : Introduction, Scheduling in Real-time Operating Systems	4
10	Memory and I/O Management : Device Drivers	2
11	Embedded Software Development : Flow, Environments and Tools	2
12	System Specification and Modelling	2
13	Programming Paradigms	2
14	System Verification	2
15	Performance Analysis and Optimisation : Speed, Power and Area Optimisation, Testing of Embedded Systems	4
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1.	S. Heath, "Embedded Systems Design", Elsevier India,2005
2.	M. Ben-Ari, "Principles of Concurrent and Distributed Programming", Pearson,2005
3.	Jane Liu, "Real Time Systems", Pearson,2002

EN-351 ENVIRONMENTAL POLLUTION AND E –WASTE MANAGEMENT

1. Subject Code: **EN-351**   Course Title: **Environmental Pollution & E- Waste Management**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE) (Hrs.): Theory: 3 Hrs.   Practical: 0
4. Relative Weightage   : CWS   25   PRS 0   MTE   25   ETE 50   PR 0
5. Credits   : 3
6. Semester   : VI
7. Subject Area   : OEC
8. Pre-requisite   : Nil
9. Objective   : The overall aims of the course are for students to acquire understanding of the new and emerging contaminants from various industrial processes and their transformation products. Studying emerging environmental issues related to newer methods of manufacture of industrial products.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1	**UNIT-I** New and emerging pollutants and related transformation products, Effects & risks of emerging contaminants on ecosystems and humans, Persistent pollutants. Analytical methods for identifying emerging pollutants and the products of their transformation	9
2	**UNIT-II** Micro pollutants- Pesticides, Pharmaceutical - Veterinary and human drugs, personal care products, Surfactants and surfactant metabolites, Flame retardants, Industrial additives and agents. Emerging pollutants' toxicity, and their water-related characteristics (degradability, solubility, sorption…)	9
3	**UNIT-III** Emerging Issues - E-waste, Hazardous Waste, Nuclear Waste, Nano pollution, Thermal Pollution, pollutant emission and treatment	8
4	**UNIT-IV** Emerging pollutants' emergence and fate in surface and ground water, as well as mathematical modelling, Sustainable Development, Risk mitigation	8

5	**UNIT-V** Transformation Products of Emerging Contaminants in the Environment, Removal of emerging contaminants from water, soil and air, methods and preventive measures.	8

Course Outcome:

1. Introduction to new and emerging contaminants and their transformation products.
2. Study of pollutants from manufacturing of goods.
3. Emerging area in environmental pollution.
4. Study of life cycle of a contaminant, modeling and mitigation.

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1.	G. Buttiglieri, T.P. Knepper, (2008), Removal of emerging contaminants in Wastewater Treatment: Conventional Activated sludge Treatment, Springer-Verlag Berlin Heidelberg, HdbEnvChem, vol. 5, Part S/2:1-35, DOI: 10.1007/698_5_098
2.	Alok Bhandari; Rao Y. Surampalli; Craig D. Adams; Pascale Champagne; Say Kee Ong; R. D. Tyagi; and Tian Zhang, Eds., (2009) Contaminants of Emerging Environmental Concern, American Society of Civil Engineers, ISBN (print): 978-0-7844-1014-1, ISBN (PDF): 978-0-7844-7266-8
3.	Dimitra A. Lambropoulou, Leo M. L. Nollet Eds. () Transformation Products of Emerging Contaminants in the Environment: Analysis, Processes, Occurrence, Effects and Risks, 1st Edition, Wiley, ISBN-13: 978-1118339596, ISBN-10: 1118339592

EN353 OCCUPATIONAL HEALTH AND SAFETYMANAGEMENT

1. Subject Code : **EN- 353**   Course Title: **Occupational Health and Safety Management**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs
4. Relative Weightage   : CWS 25   PRS 0   MTE 25   ETE 50   PR 0
5. Credits   : 3
6. Semester   : V
7. Subject Area   : OEC
8. Prerequisite   : Nil
9. Course Objectives   :
   1. Introduction about occupational health and related issues.

2. To give a basic idea about environmental safety management, industrial hygiene.
3. To introduce about training cycle, chemical hazards and control measures.
4. To aware and provide knowledge about ergonomics and different disorders.
5. To provide knowledge about different standards related to safety and health.

10. Detail of Course   :

Unit No.	Contents	Contact Hours
1	**UNIT –I** Definition of Occupational Health as per WHO/ILO. Occupational Health and Environmental Safety Management – Principles practices. Common Occupational diseases: Occupational Health Management Services at the work place. Pre-employment, periodic medical examination of workers, medical surveillance for control of occupational diseases and health records.	8
2	**UNIT –II** Occupational Health and Environment Safety Management System, ILO and EPA Standards. Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.	8
3	**UNIT –III** Element of training cycle, Assessment of needs. Techniques of training, design and development of training programs. Training methods and strategies types of training. Evaluation and review of training programs. Chemical Hazard: Introduction to chemical hazards, dangerous properties of chemical, dust, gases, fumes, mist, Vapours, Smoke and aerosols. Evaluation and control of basic hazards, concepts of dose response relationship, bio-chemical action of toxic substances. Concept of threshold, limit values.	9
4	**UNIT –IV** Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Exposure Limit. Ergonomics-Introduction, Definition, Objectives, Advantages. Ergonomics Hazards. Musculo skeletal Disorders and Cumulative Trauma Disorders. Physiology of respiration, cardiac cycle, muscle contraction, nerve conduction	9

	system etc. Assessment of Workload based on Human physiological reactions. Permissible limits of load for manual lifting and carrying. Criteria or fixation limits.	
5	**UNIT –V** Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards, Performance measurements to determine effectiveness of PSM. Importance of Industrial safety, role of safety department, Safety committee and Function.	8

Course Outcomes:
1. The student will be able to understand the basics of occupational health and related issues.
2. Understanding of the fundamental aspects of safety, industrial hygiene along with learning theory to safety training methodology.
3. Considerate about hazardous materials, emergency management, ergonomics and human factors
4. Able to understand the adverse effects of hazards and develop control strategies for hazardous conditions and work practices
5. Learn about Indian standards of health and safety and able to apply applicable standards, regulations and codes.

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1.	Handbook of Occupational Health and Safety, NIC, Chicago, 1982.
2.	Encyclopedia of Occupational Health and Safety, Vol. I and II. International Labour Organisation, Geneva, 1985.
3.	Accident Preventional Manual, NSC Chicago, 1982.
4.	Henrich, H.W., Industrial Accident Prevention, McGraw Hill, 1980.

EN-355 GIS & REMOTE SENSING

1. Subject Code:**EN-355**   Course Title: **GIS & Remote Sensing**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE) (Hrs.) : Theory   3 Hrs
4. Relative Weightage   : CWS   25   PRS 0   MTE 25   ETE 50   PRE 0
5. Credits   : 3
6. Semester   : V

7. Subject Area   : OEC
8. Prerequisite   : Nil
9. Course Objectives   :
   1) Introduce GIS and its significance in engineering and science.
   2) To familiarize students with GIS data and its applications.
   3) To familiarize students about the basics of remote sensing and its multi concepts.
   4) To disseminate knowledge about sensors and different kind of resolution in the area of remote sensing.
   5) To familiarize students about the diverse applications of remote sensing.
10. Detail of Course   :

Unit no.	Contents	Contact Hours
1	Unit-1: Geographic Information SystemIntroduction, Definition of GIS, Components of GIS, Input data for GIS, Geographical concepts	7
2	Unit-2: GIS DataGIS data types, Data representation, Data sources, Geo-referencing of GIS data, GIS database, Database Management System, Data analysis terminology, GIS software packages, GIS application	9
3	Unit-3: Remote SensingIntroduction to Remote Sensing and Remote Sensing System, Multi concept of remote sensing, Advantages and disadvantages of remote sensing, Electromagnetic radiation, Polarisation, Thermal radiation	8
4	Unit-4: Remote Sensing PlatformsImportant remote sensing satellites, Classifications of sensors and platforms, Passive and Active sensors, Major remote sensing sensors, Spatial resolution, Spectral resolution, Radiometric resolution, Temporal resolution, Glopal Positioning System	9
5	Unit-5: Application of Remote SensingDigital Image Processing, Application of Remote Sensing in Land use and Land cover mapping, Ground water mapping, Urban growth studies, Wasteland mapping, Disaster management, Agriculture, Forestry application	9

Course Outcomes:
   1. The Student will learn about basics of GIS and its significance.

2. The Student will be able to understand the utility of GIS data as well as Data Management System.
3. The Student will learn the fundamentals of remote sensing.
4. The unit of Remote Sensing Platform will generate a clear cut understanding among students about the satellites, their functioning and Global Positioning System. Geographical information system, its components, DMS and its various applications in real life.
5. The Student will be able to attain thorough knowledge about the application of remote sensing in different areas.

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1.	Fundamentals of Remote Sensing – George Joseph, University Press, Hyderabad, India.
2.	Remote Sensing and Geographical Information System – AM Chandra & SK Ghosh Narosa Publishing House, New Delhi.
3.	Concepts and Techniques of Geographic Information Systems – C. P. Lo & Albert K.W. Yeung, PHI Learning Private Limited, New Delhi.
4.	Geographic Information System – Kang Tsung Chang, Tata Mc Graw hill, Publication Edition, 2002.

EP351 PHYSICS OF ENGINEERING MATERIALS

1. Subject code: **EP351**   Course title: **Physics of Engineering Materials**
2. Contact Hours   : L: 3 T: 0 P: 0
3. Examination Duration (Hrs)   : Theory: 3   Practical: 0
4. Relative Weight   : CWS: 25 PRS: 0 MTE: 25   ETE: 50   PRE: 0
5. Credits   : 3
6. Semester   : ODD
7. Subject area   : OEC
8. Pre-requisite   : NIL
9. Objective   : To familiarize the fundamentals /basic concepts and advances of the different materials keeping in view of the engineering applications. There is ample opportunity to become involved in cutting edge Materials Science and Engineering Research
10. Detail of Course   :

Unit No.	Contents	Contact Hours
1.	**Crystallography:**Introduction to crystal physics,Space lattice, Basis and the Crystal structure, Bravais lattices; Miller indices, simple crystal structures,Interplanar spacing, Intra and Intermolecular bonds (Ionic, Covalent, Metallic, Van der Waals and Hydrogen Bond), Defects in crystals, Basics of X- ray diffraction and its applications	10
2.	**Semiconductors:**Band theory of solids, Intrinsic and Extrinsic semiconductors, Statistics of electrons and holes in intrinsic semiconductor, Hall effect, Effect of temperature on conductivity, Generation and recombination, drift and diffusion current, Einstein relation, Applications of Semiconducting Materials.	10
3.	**Dielectric and Magnetic Materials***Dielectric Materials:* Dielectric polarization and dielectric constant, Various polarization processes, Applications of Dielectric Materials*Magnetic Materials:* Concept of Magnetism, Classification of dia-para, Ferro, Antiferro and Ferrimagnetism, ferrites, soft and hard magnetic materials, Applications of Magnetic Materials	07
4.	**Superconductivity:**Introduction and historical developments; General properties of super conductors, Meissner effect and its contradiction to the Maxwell's equation; Types of Superconductors, London equations, Penetration depth, High Temperature Superconductors, Applications of superconductors.	07
5.	**Advanced Engineering Materials:**Introduction, Synthesis, characterization and applications of Photonic glasses, Phosphors and Nanophosphors, other selective topics in advanced materials.	08
Total		42

11. **Suggested Books:**

S. No.	Name of Books/ Authors
1.	Introduction to Solid State Physics, by C. Kittel, 1996/ John Wiley & sons
2.	Solid State Physics, by S. O. Pillai, 2010/ New Age International (P) Ltd.
3.	Materials Science and Engineering by V. Raghavan, 2009/PHI Learning Pvt. Ltd.
4	.Solid State Physics, N. W. Ashcroft and N. D. Mermin, 1976/ HBC Publication
5.	Engineering Materials Science by Milton Ohring, 1995/Academic Press

6.	Material Science and engineering: An Introduction By W. D. Callister Junior, 2007/ John Wiley & Sons, Inc
7.	Handbook of Electronic and Photonic Materials by SafaKasap, Peter Capper (Eds.), 2006/Springer

EP353 NUCLEAR SECURITY

1. Subject code: **EP353**   Course title: **Nuclear Security**
2. Contact Hours   :   L: 3   T: 1   P: 0
3. Examination Duration (Hrs)   :   Theory: 3   Practical: 0
4. Relative Weight   :   CWS: 25, PRS:—, MTE: 25, ETE: 50, PRE: —
5. Credits   :   4
6. Semester   :   EVEN/ODD
7. Subject area   :   OEC
8. Pre-requisite   :   Basic knowledge of Nuclear Physics
9. Objective   :   This course will provide basic understanding of Nuclear Security which is essential for establishing nuclear culture in the society
10. Detail of Course   :   5th/6th Semester

S. No.	Contents	Contact Hours
1.	Introduction to nuclear security: Basics of nuclear security, Practice and culture, Background, Objective, Scope, Structure, Nuclear security and safety culture: Characteristics of nuclear security culture	**08**
2.	Nuclear security regime, Importance of human factor and management leadership in nuclear security, Nuclear security threats: Threat informed security, The design basis threat	**07**
3.	System characterization, PPS requirements and objectives: Facility characterization, Target identification, Consequence analysis, PPS performance objectives	**06**
4.	Physical protection system technologies: Intrusion detection, Exterior and Interior Sensors, Access control, Contraband detection, Field detection sensors at borders/major public Events, Alarm assessment, Communication and display, Access delay, Response and neutralization, Response strategies and impact of On and Off site response, Cyber security.	**09**

5.	Security system design and evaluation: Adversary path analysis and Multi path optimization, Scenario development, Insider analysis, Transportation, Design approaches and vulnerability assessments, System design at major public events, Design of security systems to interrupt illicit trafficking, Analysis of quantitative risk assessment methods.	**08**
6.	Consequence mitigation and event response: Consequence management following nuclear events, Analysis of deterrence value of security measures, Roles and responsibilities of institutions and individuals	**04**
	Total	**42**

11. **Suggested Books**

S. No.	Name of Books/ Authors
1.	Nuclear security briefing book, by Wyn Bowen, Matthew Cottee, Chris Hobbs, Luca Lentini and Matthew Moran, 2014/King's College, London, UK
2.	IAEA Nuclear Security Series No. 13, Nuclear Security recommendations on physical protection of nuclear material and nuclear facilities by IAEA, 2011/ International Atomic Energy Agency (IAEA)
3.	The International Legal Framework of Nuclear Security: IAEA International law series No. 4 by IAEA, 2011/International Atomic Energy Agency (IAEA)
4.	Seeking Nuclear Security Through Greater International Cooperation by Jack Boureston and Tanya Ogilvie-White, 2010/Council on Foreign Relations (CFR's) International Institutions
5.	Book Review: South Asia's Nuclear Security by Bhumitra Chakma , 2015/Oxon, UK, Routledge

HU351 ECONOMETRICS

1. Elective Paper - Econometrics

During	Subject Code	Open for Branches	Per week- L-T-P semester	During
Odd semester	351	MC, CE, EN, BT, EP, PS	3-0-1	5 th
Even semester	352	EE, EL, CO, SE, AE, ME,	3-0-1	6 th
		PE		

(Note: i. History of this subject in DTU is different from other subjects. This subject was demanded by the students in final year. It is supported by the placement data also that number of non-technical companies visiting campus for recruitment is increasing over year.

2. Examination Duration   :   3 Hrs.
3. Relative Weightage   :   will be decided at University level
4. Credits   :   3 (Four)
5. Semester   :   Fifth and Sixth Semester
6. Subject Area   :   OEC Economics (Social Science)
7. Pre-requisite   :   Nil
8. Details of Course   :

Syllabus   **Hours (Total - 56)**

Unit	Contents	Contact Hrs
1	Introduction	6
	1.1 What is Econometrics? Why a separate discipline? How it is different from Mathematical Economics, Type of Data, Sources of data	
	1.2 Estimating Economic Relationship, Methodology of Econometrics	
	1.3 Matrix and its Economic Application	
2	Review of Calculus	12
	2.1 Differential Calculus and its application in Economics- Elasticity of demand Price and Cross; Profit maximization under Perfect Competition, Monopoly, Oligopoly and Monopolistic Competition	
	2.2 Integral Calculus and its application in Economics - Capital Formation, Compound Interest; Capital value and Flow Value; Consumer surplus under pure competition and monopoly; Producers Surplus	
	2.3 Differential Equation and its application in Economics – Market Price Function; Dynamic Multiplier;	
3.	Review of Statistics	14
	3.1 Basic Ingredients of an Empirical study- Formulating a Model; Gathering data Descriptive Statistics and its use in Business- Measure of Central Tendency: AM, GM and HM, Median, Mode, Dispersion, Range, Quartile, standard Deviation, Skewness, Kurtosis,	

	3.2 Probability - Discrete and Continuous; Probability Distribution: Binomial and Poison distribution	
	3.3 Sampling techniques, Estimation and Hypothesis Testing, Interpreting the results	
Mid semester		
4.	Regression	8 Hours
	Statistical verses Deterministic Relationships, Regression verses Causation; Two variable Regression Analysis; Population Regression Function (PRG), Stochastic specification of PRF; The Significance of the Stochastic Term; stochastic disturbance Term; the sample regression Function (SRF); Method of Ordinary Least Squares; Properties of Least Square Estimators: The Gauss-Markov Theorem, Coefficient of determination r^2 : A Measure of "goodness of fit"; Monto Carlo Experiments	
5.	Classical Normal Linear Regression Mode (CNLRM)	4 Hours
	The Probability distribution of Disturbances (meu); Normality Assumption, Method of Maximum LikelihoodMultiple regression Analysis: The Problem of estimation; The problem of InferenceCobb-Douglas Production function; Polynomial Regression Model; Testing for structural or Parametric stability of regression Models; the Chow test	
6.	Dummy Variable (DV)	6 Hours
	Nature; ANOVA models; Regression with a mixture of Quantitative and Qualitative regressors: The ANCOVA Models; DV alternative to the Chow Test; Interaction effects using Dummy Variable; Use of DV in seasonal Analysis	
7.	Presentation on Application of Mathematics, Statistics, Operational Research , Computer Science or any other related subject to discuss any Aspect of Economics	6 hrs.

11. **Suggested books**

S.No.	Name of Books, Authors, Publishers
1.	Wooldridge Jeffrey , Introductory Econometrics, Cencage Learning- ISBN-13-978-81-315-1673-7; ISBN-1081-315-1673-3,2014
2.	Damodar N. Gujrati, Basic Econometrics, Mcgraw Hill Education (India) Limited, Fifth Edition,2013 ISBN-978-0-07-133345-0; ISBN; 0-07-133345-2
3.	Ramu Ramanathan, Introductory Econometrics with Applications, Harcourt Brace Jovanovich Publishers, Latest USA ISBN-

MA351 HISTORY CULTURE & EXCITEMENT OF MATHEMATICS

1. 1 Subject Code: **MA351**   Course Title: **History Culture and Excitement of Mathematics**
2. Contact Hours   : L-3   T-0   P-0
3. Examination Duration (Hrs)   : Theory: 3hrs
4. Relative weightage   : CWS: 25   PRS: -   MTE: 25   ETE: 50   PRE: 0
5. Credits   : 3
6. Semester   : Odd
7. Subject Area   : OEC
8. Pre requisite   : —
9. Objective   : To be capable in learning the history and culture on the Mathematics subjects

Unit No.	Contents	Contact Hours
1.	Ancient, Medieval and Modern Indian Mathematics: Aryabhata, Brahmagupta, Bhaskar, Lilavati, Ramanujan	7
2	Introduction to Ancient books of Indian Mathematicians: Sidhantas, Sulvasutras, Vedic Mathematics	7
3	Contribution of Indian Mathematicians in the field of Mathematics: Value of Pi, The symbol zero, Number theory, Trigonometry, and Mensuration, Hindu Multiplication, Long Division, Indeterminate equation	7
4	Mathematicians Around the world: Newton, Leibnitz, Cauchy, Lagrange in the field of Geometry, Calculus, Algebra, Probability	7
5	Algebra in the Renaissance: Solution of cubic equation, Ferrari's Solution in the quartic equation, Irreducible Cubics and complex numbers	7
6	Paradoxes, Fallacies and Pitfalls of Mathematics	7
	Total	**42**

11. **Suggested books**

S.No.	Name of Books, Authors, Publishers
1.	History of Mathematics, by carl B Boyer, Wiley International edition, 1968.
2.	Mathematics of Music, Susan Kelly, UW-L Journal of under graduate research, Vol-XIV, 2011.

ME 351 POWER PLANT ENGINEERING

1. Subject Code: **ME 351**   Course Title: **Power Plant Engineering**
2. Contact Hours: 42   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   3
6. Semester   :   V
7. Subject Area   :   OEC
8. Pre-requisite   :   NIL
9. Objective   :   To familiarize the students with thermodynamic cycles and various components of power plants.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	Indian energy scenario, Indian coals: formation, properties, analysis, benefication and heating value calculation of coals; coking and non-coking coals, fuel handling systems; coal gasification. Classification of power plants, base load and Peak load power stations, co-generated power plant, captive power plant, and their fields of application & selection criteria.	7
2	**Steam Generators:** High pressure utility boiler, natural and forced circulation, coking and non-coking coal, coal benefication, coal pulverization, pulverized fuel firing system, combustion process, need of excess air, cyclone furnace, fluidized bed boiler, electrostatic precipitators and wet scrubbers, boiler efficiency calculations, water treatment.	7
3	**Combined Cycle Power Plants:** Binary vapour cycles, coupled cycles, gas turbine- steam turbine power plant, gas pipe line control, MHD- Steam power plant.	7
4	**Other power plants:** Nuclear power plants - working and types of nuclear reactors, boiling water reactor, pressurized water reactor, fast breeder reactor, controls in nuclear power plants, hydro power plant -classification and working of hydroelectric power plants, tidal power plants, diesel and gas power plants.	7
5	**Instrumentation and Controls in power plants:** Important instruments used for temperature, flow, pressure, water/steam	7

	conductivity measurement; flue gas analysis, drum level control, combustion control, super heater and re-heater temperature control, furnace safeguard and supervisory system (FSSS), auto turbine run-up system(ATRS).	
6	**Environment Pollution and Energy conservation:** Economics of power generation: load duration curves, power plant economics, pollution from power plants, disposal/management of nuclear power plant waste, concept of energy conservation and energy auditing.	7
	Total	**42**

11.   **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	**Power Plant Engineering** by M.M. Elwakil, Tata McGraw Hill, ISBN- 0070662746.
2	**Power Plant Engineering** by P.K Nag, Tata McGraw Hill, ISBN- 0070435993.
3	**Steam and Gas turbines** by A Kostyuk and V Frolov, MIR Publishers, ISBN- 9785030000329.
4.	**Modern Power Plant Engineering** by J Wiesman and R Eckart, Prentice hall India Ltd, ISBN- 97801359725.
5.	**Planning Fundamentals of thermal Power Plants** by F.S Aschner, John Wiley, ISBN- 07065159X.
6.	**Applied Thermodynamics** by T.D Eastop and McConkey, Longman Scientific and Technical, ISBN- 0582305351.
7.	**CEGB volumes on power plant, Cwntral Electricity Generation Board, ISBN- 0080155680.**
8.	**NTPC/NPTI publications on Power plants**, ISBN- 9788132227205.

ME353 RENEWABLE SOURCES OF ENERGY

1. Subject Code : **ME 353**   Course Title: **Renewable Sources of Energy**
2. Contact Hours: 42   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   3
6. Semester   :   V
7. Subject Area   :   OEC

8. Pre-requisite   :   NIL

9. Objective   :   To familiarize the students with renewable energy sources like solar, geothermal, wind and tidal.

10. Details of Course   :

Unit No.	Contents	Contact Hours
1	Man and Energy, world production and reserve of conventional energy sources, Indian production and reserves, Energy alternatives	7
2	Solar radiation: Origin, nature and availability of solar radiation, estimation of solar radiation. Photovoltaic cells. Design consideration and performance of different types of solar cells. Flat plate, focusing collectors. Effects of receiving surface location and orientation.	7
3	Devices for solar thermal collection and storage. Energy storage devices such as water storage systems, packed Bed storage systems, phase change storage systems. Heat transfer considerations relevant to solar energy. Characteristics of materials and surfaces used in solar energy absorption.	7
4	Application systems for space heating, solar water pumps, solar thermal pond, Solar Thermal Power plants, solar distillation, Solar Refrigeration and solar air conditioning, other solar energy utilization.	7
5	Solar PV systems. Fuel Cell Technologies.Generation and utilization of biogas, design of biogas plants, Wind energy systems.	7
6	Geothermal Energy Systems. Tidal energy systems. Oceanic power generation. Design considerations, Installation and Performance Evaluation. MHD power generations. Role of the nonconventional energy sources in power planning.	7
Total		**42**

11.   **Suggested Books**:

S. No.	Name of Authors /Books / Publishers
1	G. D. Rai, "Energy Technolgy", Khanna Publishers, ISBN- 97881740907438.
2	S.P. Sukhatme, " Solar Energy", Tata-Mcgraw hill, New Delhi, ISBN- 0074624531.
3	"Solar Energy thermal process" JADuffie and W.A. Beckman, John Wiley& sons, New York, ISBN- 1118418123.

4	Solar energy, Frank Kaieth& Yogi Goswami, Taylor and Francis, ISBN- 1560327146.
5	Treatise of Solar Energy, H.P. Garg, John Willey & sons, ISBN- 9027719306.

ME355 COMBUSTION GENERATED POLLUTION

1. Subject Code: **ME 355**   Course Title: **Combustion Generated Pollution**
2. Contact Hours: 42   : L: 3   T: 0   P: 0
3. Examination Duration (Hrs.) : Theory: 3   Practical: 0
4. Relative Weight   : CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   : 3
6. Semester   : V
7. Subject Area   : OEC
8. Pre-requisite   : NIL
9. Objective   : To introduce the students to different types of fuels, emissions from various engines, exhaust treatment of various engines and instruments used for measuring emissions.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1	Engine fundamentals: Fuels, alternative fuels for IC engines, Type of hydro carbons. Gasoline specifications. Effect of Engine parameters on performance, fuel injection for SI engines, Engine vehicle road performance, road performance and fuel economy.	7
2	Emissions and air pollution: Automotive Emissions and their role in air pollution. Photo-chemical smog. Chemistry of smog formation. Combustion in Homogeneous mixtures, emission formation. Incomplete combustion, formation of hydro-carbons, Carbon monoxide and oxides of nitrogen, Aldehyde emissions.	7
3	Influence of design and operating variables on gasoline engine exhaust 7emissions.Hydrocarbon Evaporative Emissions: Various sources and methods of their control. Canisters for controlling evaporative emissions. Emission control systems for gasoline engines: Blow by control closed PCV system design.	
4	Exhaust treatment devices: Air injection into exhaust system.	7

5	Thermal reactors, Catalytic convertor.Stratified charge engines. Honda CVCC engine.Diesel engine combustion Emissions: Sources of emissions during combustion. Effect of air fuel ratio, speed, injection timing on performance and emission formation. D.I and I.D.I engine emissions.	7
6	Methods of reducing emissions, exhaust gas recirculation, smoke emission from diesel engines.Emission Instruments: Non- dispersive Infrared analyzer, Gas chromatograph, flame ionization detector, chemiluminescent analyzer	7
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Combustion generated air pollution, Earnest S Starkman, Springer, ISBN-9780306305302.
2	Fundamentals of Air pollution engineering, Richard C. Hagan, Prentice Hall, ISBN-0133325371.
3	Air pollution threat & response, David Alym, Addison-Wesley Publication, ISBN-0201043556.

ME357 THERMAL SYSTEM

1. Subject Code: **ME 357**   Course Title: **Thermal System**
2. Contact Hours: 42   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight: CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   3
6. Semester   :   V
7. Subject Area   :   OEC
8. Pre-requisite   :   NIL
9. Objective   :   To familiarise the students with the process of thermodynamic analysis of engineering systems and to enhance critical thinking and provide them with a wider view to handle engineering problems.
10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Fundamentals**: properties of pure substance in Solid, Liquid and Vapour Phases, PVT Behavior of simple compressible system, T-S and H-S diagram, Steam Tables, determination of quality of steam, Throttling Calorimeter, Combined Separating & Throttling Calorimeter, Maxwell and other thermodynamics relations, mixture of non reactive ideal gases, Real gases, Compressibility chart, Law of corresponding state, Air water vapor mixture, calculation of properties of air water vapour mixture.	7
2	**Rankine Cycle And Analysis**: Rankine cycle and its representation on T-S and H-S diagrams; Effect of low backpressure and high entry pressure and temperature and its limitations; necessity of re-heating, ideal and actual regenerative feed water heating cycle and its limitations. Typical feed water heating arrangements for various capacity power plants.	7
3	**Introduction To Boilers**: Classification of Boilers, Boiler mountings and accessories; draft systems, circulation system; Combustion and its calculations, and Boiler performance.	7
4	**Steam Nozzles**: Types of Nozzles, Flow of steam through nozzles; Condition for maximum discharge through nozzle; Nozzle efficiency. Effect of friction and Supersaturated flow through nozzle.	7
5	**Steam Turbines** : Working principle and types of steam turbines; Velocity diagrams for impulse and reaction turbines, compounding of impulse turbines; Optimum velocity ratio and maximum efficiency. Comparison of impulse and reaction turbines. Condition line and reheat-factor, losses in steam turbines; governing of steam turbines.	7
6	**Condensers and Cooling towers**: Types and working of condensers, types and performance of cooling towers.	7
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	**Engineering Thermodynamics** by P.K.Nag, Tata McGraw Hill Publishing Company Limited, ISBN – 1259062562, 2013.
2	**Engineering Thermodynamics**byRogers, Pearson Education, ISBN- 631197036.
3	**Thermodynamics** by Kenneth Wark, Mcgraw-hill Book Company, 5th edition, ISBN- 0070682860, 1988.

4.	**Engineering Thermodynamics: work and heat transfer** by Gordon Rogers and Yon Mayhew, Longman, 4th edition, ISBN – 0471861731, 1992.
5.	**Fundamentals of Classical Thermodynamics** by Van Wylen and Sonntag, John Wiley & Sons Inc., 3rd edition, ISBN – 0471861731, 1986.
6.	Fundamentals of Engineering Thermodynamics by Moran and Shaprio, John Wiley & Sons, Inc., 7th edition, ISBN - 0470917687, 2010.
7.	Thermodynamics: An Engineering Approach by Cengel and Boles, The McGraw-Hill Companies, 8th edition, ISBN: 0073398179, 2014.
8.	Applied Thermodynamics for Engineering TechnologistsbyT.D. Eastop, Prentice Hall, 5th edition, ISBN- 05820919344, 1993.
9.	Treatise on Heat Engineering by V. P.Vasandani and D.S. Kumar, Metropolitan Book Co. (p) Ltd., ISBN- 810003500.

ME359 REFRIGERATION & AIR CONDITIONING

1. Subject Code: **ME 359** Course Title: **Refrigeration and Air Conditioning**
2. Contact Hours: 42 L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To learn properties of different refrigerants, and thermodynamic cycles of refrigeration.To understand comfort parameters and air conditioning.
10. Details of Course :

Unit No.	Contents	Contact Hours
1	**Introduction to Refrigeration**: Necessity and applications, unit of refrigeration and C.O.P., types of Ideal cycles of refrigeration, air-refrigeration, bell coleman cycle, open and dense air systems, actual air-refrigeration system problems, refrigeration needs of aircrafts, actual refrigeration system	7
2	**Vapour Compression Refrigeration**:Working principle and essential components of the plant, simple vapour compression refrigeration	10

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	cycle - COP, Representation of cycle on T-S and p-h charts - effects of sub cooling and super heating - cycle analysis - Actual cycle, Influence of various parameters on system performance – necessity of multistaging, multistage compression system, and their analysis, necessity and working of cascading system	
3	**Refrigerants and Absorption Refrigeration:**Desirable properties of refrigerants, classification of refrigerants used, nomenclature, ozone depletion, global warming, vapor absorption system, calculation of max COP.	4
4	**Air Conditioning**:Psychometric properties & processes, comfort air-conditioning, summer and winter air-conditioning, cooling & dehumidification systems, load calculation and applied psychrometry.	7
5	**Human Comfort:**Requirements of human comfort and concept of effective temperature, comfort chart, comfort air-conditioning, requirements of industrial air-conditioning, air-conditioning load calculations.	7
6	**Control:**Refrigeration and air-conditioning control, air handling, air distribution and duct design	7
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	**Refrigeration and Air Conditioning** by C. P. Arora, Tata McGraw Hill, ISBN-9788120339156.
2	**Refrigeration and Air Conditioning** by A. R .Trott and T. C. Welch, Butterworth-Heinemann, ISBN- 9780080540436.
3	**Refrigeration and Air ConditioningTechnology** by Whitman, Jhonson and Tomczyk, Thomson Delmer Learning, ISBN- 1111644470.
4	**Refrigeration and Air Conditioning** by Abdul Ameen, Prentice Hall of India Ltd, ISBN- 9789303206560..
5	**Basic Refrigeration and Air Conditioning** by P. N. Ananthanarayan, Tata McGraw Hill, ISBN- 9789383286560.
6	**Refrigeration and Air Conditioning** by Wilbert F. Stoecker and Jerold W. Jones, Tata McGraw Hill, ISBN- 007061623X.

7	**Refrigeration and Air Conditioning by** Richard Charles Jordan, Gayle B. Priester, Prentice hall of India Ltd, ISBN-9780406269313.
8	**ASHRAE Handbook – Refrigeration 2010,** ISBN- 9781933742922.

ME361 INDUSTRIAL ENGINEERING

1. Subject Code: **ME361**   Course Title: **Industrial Engineering**
2. Contact Hours: 42   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   4
6. Semester   :   V
7. Subject Area   :   OEC
8. Pre-requisite   :   NIL
9. Objective   :   To make students aware of industrial engineering concepts of work study and measurement, quality control and reliability etc.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1	**Introduction**Introduction, Definition and objectives of Industrial Engineering, Scope of Industrial Engineering, Production systems and their classifications; Productivity-Total and partial productivity, Reasons and remedy for poor productivity	7
2	**Job analysis and Work Measurement Systems**Work System Design: Taylor's scientific management, Gilbreth's contributions; method study, micro-motion study, principles of motion economy; work measurement - stop watch time study, micro motion and memo motion, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes, and wage administration; business process reengineering	7
3	**Production Planning and Control**Types and characteristics of production systems Objective and functions of Production, Planning & Control, Routing, Scheduling and Operations scheduling, production scheduling, job shop scheduling problems, sequencing problems, scheduling tools and techniques, Loading, Dispatching and its sheets & Gantt charts	7

4	**Quality Engineering** Quality concept and costs; statistical quality control, Concept of specification limits, statistical control limits, process capability, Process control and control charts for both attributes and variable data. Acceptance Sampling- Single and double sampling	7
5	**Reliability and Maintenance** Reliability, availability and maintainability; distribution of failure and repair times; determination of MTBF and MTTR, reliability models; system reliability determination; Maintenance management and its objectives, Various types of Maintenance Planning, House Keeping, 5S concepts	7
6	**Material Handling** Principles, functions, and objectives of Material Handling; Selection and classification of Material Handling Equipments; Relation of material handling with plant layout	7
	Total	**42**

11. **Suggested Books**

S. No.	Name of Authors /Books / Publishers
1	Industrial Engineering and Management; B. Kumar, Khanna Publication, ISBN- 8174091963, 2011.
2	Introduction to work Study, International Labour Office, Geneva, 3rd edition, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi, ISBN- 8120406028, 2008.
3	Industrial Engineering and Management, Pravin Kumar, Pearson Education, 1st edition, ISBN- 9789332543560, 2015.

ME363 PRODUCT DESIGN & SIMULATION

1. Subject Code: **ME363** Course Title: **Product Design & Simulation**
2. Contact Hours: 42 L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the process of product design and development.
10. Details of Course :

Unit No.	Contents	Contact Hours
1	**Stages in design process:**Introduction to various stages of the design process: Formulation of problem, Generate alternatives, Evaluation, Guided Redesign. Case study.	5
2	**Product life cycle:**New product introduction: early introduction, increased product life. Life cycle management tool, System integration, QFD, House of quality, Pugh's method, Pahl and Beitz method. Case studies	5
3	**Value engineering:** Introduction, nature and measurement of value. Value analysis job plan. Creativity. Value analysis test. Case studies	5
4	**Concurrent/ reverse engineering:**Introduction, basic principles, components, benefits of concurrent engineering. Concept of reengineering	5
5	**Material selection:** Materials in design. The evolution of engineering materials. Design tools and material data. Material selection strategy, attribute limits, selection process, material selection. Case studies	5
6	**Process selection:** Introduction. Process classification: shaping, joining and finishing. Systematic process selection, process cost. Computer – aided process selection	5
7	**Design for manufacture and assembly:** Design for Manufacture and Assembly (DFMA). Reasons for not implementing DFMA. Advantages of DFMA with case studies. Design features and requirements with regard to assembly, Design for Manufacture in relation to any two manufacturing processes: machining and injection molding. Need, objectives	4
8	**System Simulation**: Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages	4
9	**Simulation of Mechanical Systems**: Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic systems	4
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
	TEXT BOOKS:
1	David G Ullman, "The Mechanical Design Process." Publisher-McGrawhillIncSingapore, ISBN-13: 9780072975741, 1992.
2	Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development." 1 / e 2004 , Publisher- Pearson Education New Delhi , ISBN-13: 9780130212719,
3	L D Miles "Value Engineering."Publisher- McGraw-Hill, 1972
4	Karl T Ulrich, Steven D Eppinger , " Product Design &Development."Publisher- Tata McGrawhill New Delhi, ISBN-13: 9780078029066, 2003
5	Hollins B & Pugh S "Successful Product Design." Publisher- Butter worths London, ISBN 9780408038614.
6	N J M Roozenberg , J Ekels , N F M Roozenberg " Product Design Fundamentals and Methods ."Publisher- John Willey & Sons, ISBN-13: 9780471954651, 1995.

ME365 COMPUTATIONAL FLUID DYNAMICS

1. Subject Code: **ME 365**   Course Title: **Computational Fluid Dynamics (CFD)**
2. Contact Hours: 42   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   3
6. Semester   :   V
7. Subject Area   :   OEC
8. Pre-requisite   :   NIL
9. Objective   :   To provide basic concepts of CFD in terms of comprehensive theoretical study and its computational aspects.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1	Introduction to CFD, Historical background, Impact of CFD	3

2	The Governing Equations of Fluid DynamicsDerivation, Discussion of physical meanings and Presentation of forms particularly suitable to CFD.	7
3	Mathematical Behavior of Partial Differential Equations:Impact on CFD	6
4	Basic Aspects of Discretization:Introduction to Finite Difference, Finite Elements and Finite Volume Methods.Detailed treatment of Finite Difference method, explicit and implicit methods, errors and stability analysis.	12
5	Grids with Appropriate Transformations Adaptive grids and unstructured meshes.Lift reduction, down force generation and drag reduction. An introduction to the aerodynamics of airflows for cooling.	7
6	Commercial codes (e.g. FLUENT etc.). Grid generation, techniques and application. Basic principles and concepts and the characteristics of wings and diffusers	7
Total		**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Computational Fluid Dynamics",John Anderson," McGraw- Hill Ltd.
2	Computational Fluid Dynamics",Tu, Elsevier.
3	Introduction to Computational Fluid Dynamics,Niyogi, Pearson Education, Delhi

ME367 FINITE ELEMENT METHODS

1. Subject Code: **ME 367**   Course Title: **Finite Element Methods**
2. Contact Hours: 42   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3   Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   3
6. Semester   :   V
7. Subject Area   :   OEC
8. Pre-requisite   :   NIL
9. Objective   :   To enable students to apply Galerkin method and virtual work principle to problems in solid mechanics. To teach them numerical solution of differential equations with finite element method.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1	Fundamental concepts of the Finite Element Method. One Dimensional Problem(Bar of uniform and variable cross sections), The Galerkin Approach, The potential –Energy Approach, shape Functions, Derivation of stiffness matrix and load vector for the element and for the entire domain. Evaluation of displacement, stresses and reaction forces.	12
2	**Trusses**:-. Introduction, Plane Trusses, Local and Global coordinate Systems, Element Stiffness Matrix and Stress calculations	3
3	Two –Dimensional problem using Constant strain triangles(CST), Two-dimensional isoparametric elements and numerical integration, element stiffness matrix, Force vector.	6
4	Applications of finite element method to heat transfer.	4
5	Application of finite element method to electrical systems.	10
6	**Dynamic analysis**:- Element mass matrices,Evaluation of Eigenvalues and Eigenvectors.Use of Softwares such as MAT LAB/ABAQUS/ ANSYS/ NASTRAN/IDEAS. Basic feature of these softwares.	7
Total		**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Finite Element Procedures, K.J. Bathe, Prentice Hall of India.
2	Finite Elements in Engineering by Chandrupatla and Belegundu.
3	Finite element Method by J.N.Reddy.
4.	Finite element Method,O.C. Zienkiewicz& R.A. Taylor
5.	Finite element Analysis,C.S. Krishnamurthy
6.	Finite element Method, Kenneth H. Hubener
7.	Finite Element Method, Desai & Abel

ME369 TOTAL LIFECYCLE MANAGEMENT

1. Subject Code: **ME 369**   Course Title: **Total Lifecycle Management**
2. Contact Hours: 42   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3   Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0

5.	Credits	:	3
6.	Semester	:	V
7.	Subject Area	:	OEC
8.	Pre-requisite	:	NIL
9.	Objective	:	To familiarize the students with the concept of Total Life Cycle, and applying life cycle thinking to define tradeoffs. This course also introduces to sustainability and use of renewable resources.

10. Details of Course   :

Unit No.	Contents	Contact Hours
1	**Introduction:** Extensive definition of Concurrent Engineering (CE), CE design methodologies, Review of CE techniques like DFM (Design for manufacture), DFA (Design for assembly), QFD (Quality function deployment), RP (Rapid prototyping), TD (Total design), for integrating these technologies, Organizing for CE, CE tool box, Collaborative product development	8
2	**Use of Information Technology:** IT support, Solid modeling, Product data management, Collaborative productCommerce, Artificial Intelligence, expert systems, Software hardware component design.	8
3	**Design Stage:** Lifecycle design of products, Opportunities for manufacturing enterprises, Modality of concurrent engineering design, automated analysis, Idealization control, CE in optimal structural design, Real time constraints	8
4	**Need for PLM:** Importance of PLM, Implementing PLM, Responsibility for PLM, Benefits to different managers ,Components of PLM, Emergence of PLM, Lifecycle problems to resolve, Opportunities to seize	9
5	**Components of PLM:** Components of PLM, Product lifecycle activities, Product organizational structure, Human resources in product lifecycle, Methods, techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information, Standards	9
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Integrated Product Development M.M. Anderson and L Hein IFS Publications
2	Design for Concurrent Engineering J. Cleetus CE Research Centre, Morgantown
3	Concurrent Engineering Fundamentals: Integrated Product Development Prasad Prentice hall India
4	Concurrent Engineering in Product Design and Development I Moustapha New Age International
5	Product Lifecycle Management John Stark Springer-Verlag, UK
6	Product Lifecycle Management Michael Grieves McGraw Hill
7	Concurrent Engineering: Automation tools and Technology Andrew Kusiak Wiley Eastern

ME371 VALUE ENGINEERING

1. Subject Code: **ME 371**   Course Title: **Value Engineering**
2. Contact Hours: 42   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To understand the concept and approaches of value analysis and engineering with an emphasis on case studies.
10. Details of Course :

Unit No.	Contents	Contact Hours
1	An Overview Of Value Engineering-Concepts and approaches of value analysis and engineering - importance of value, Function - identity, clarify – analysis	8
2	Evaluation of VE-Evaluation of function, Problem setting system, problem solving system, setting and solving management - decision - type and services problem, evaluation of value	8
3	Results accelerators, Basic steps in using the systems	8

4	Understanding the decision environment, Effect of value analysis on other work in the business- Life Cycle Cost (LCC), Case studies	9
5	VE Level Of Effort-VE Team, coordinator, designer, different services, definitions, construction management contracts, value engineering case studies, Effective organization for value work, function analysis system techniques- FAST diagram, Case studies	9
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Parker, D.E., "Value Engineering Theory", Sundaram publishers, 1990
2	Miles, L.D., "Techniques of Value Engineering and Analysis", McGraw Hill Book Co., 2nd End., 1972
3	Khanna, O.P., "Industrial Engineering and Management", Dhanpat Rai and Sons, 1999.

MG351 FUNDAMENTALS OF FINANCIAL ACCOUNTING AND ANALYSIS

1. Subject Code : **MG351**   Course Title: **Fundamentals of Financial Accounting and Analysis**
2. Content Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE)(Hrs.): Theory   3 Hrs   Practical 0
4. Relative Weightage   : CWS: 25   PRS   MTE: 25   ETE : 50   PR
5. Credits   : 3
6. Semester   : V (ME+AE+PE+CE+ENE+BT+MC+AP+PT)/ VI (COE+IT+SE+EC+ EE+EEE)
7. Subject Area   : OEC Management
8. Pre-requisite   : Nil
9. Objective   : Familiarizing the students with the financial environment of business, especially the financial markets and acquaint them with accounting mechanics, process and system.
10. Details of Course   :

Unit No.	Detail Contents	No. of Hrs.
1	**Introduction to Management** :Basic concepts of management, management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2	**Introduction to Financial Environment and accounting:** Financial Markets - Capital Markets, Basics of capital market mechanism, instruments, financing and rating institutions. Importance, Objectives and Principles of Accounting, Accounting Concepts and conventions, and the Generally Accepted Accounting Principles (GAAP) Overview of the Accounting Process. Accounting standards as Issued by Institute of Chartered Accountants of India (ICAI).	10
3	**Overview of Business Activities and Principal Financial Statements:** Observe the types of information provided by the three principal financial statements and how firms might use this information in managing and evaluating a business. Understand the rationale and the information value of the statements of Balance Sheet, Profit and Loss statement, cash flows.	8
4	**Financial Analysis-I:** Distinction between cash profits and book profits. Understanding the cash flow statement and the funds flow statement.	8
5	**Financial Analysis –II**: Importance, objectives and concept of Ratio Analysis- Liquidity, leverage, solvency and profitability ratios.	8
Total		**42**

11.   **Suggested Books**

S. No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,2011, ISBN- 978-0273755869
2	Introduction to Accountancy, 10 ed., T.S. Grewal, S. Chand and Company (P) Ltd., New Delhi,2009, ISBN- 9788121905695
3	Advance Accounts by M.C Shukla and T.S Grewal and SC Gupta, S. Chand and Company (P) Ltd., New Delhi,1997, ISBN- 9788121902786

4	Financial Accounting, 4 ed, S.N. Maheshwari and S.K. Maheshwari, Vikas Pulication,2005, ISBN- 8125918523
5	Financial Accounting Reporting & Analysis, Cengage, 7/e, W AlbrechtStice & James Stice, Cengage Learning,2010, ISBN- 0538746955

MG353 FUNDAMENTALS OF MARKETING

1. Subject Code : **MG353**   Course Title : **Fundamentals of Marketing**
2. Content Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE)(Hrs.): Theory: 3 Hrs   Practical 0
4. Relative Weightage   : CWS:25   PRS   MTE:25   ETE:50   PR
5. Credits   : 3
6. Semester   : Third (ME+AE+PE+CE+ENE+BT+MC+AP+PT)/ Fourth (COE+IT+SE+EC+ EE+EEE)
7. Subject Area   : OEC Management
8. Pre-requisite   : Nil
9. Objective   : The basic objective of this paper is to make students aware of fundamental concepts of marketing necessary for making decisions in complex business situations by managers and start up entrepreneurs.
10. Details of Course   :

Unit No.	Detail Contents	No. Of Hrs.
1	**Basic concepts of management**: management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2	**Introduction to marketing**: nature and scope of marketing, marketing mix, marketing vs. sales, role of marketing in society, interface of marketing with other departments in organization, Customer Life Time Value, ethical issues in marketing Concept of market segmentation: consumer and industrial, targeting and positioning, sales forecasting	9
3	**Product mix decisions:** new product development process, test marketing, concept of Product Life Cycle, product packaging decisions	8

4	**Pricing decisions** : consideration in setting price, major pricing strategies, promotional mix decisions: advertising, sales promotion, personal selling, publicity, opportunities and avenues of online promotion	9
5	**Promotion and distribution decisions** :design and management of distribution channel for physical products and services, reasons of channel conflict, handling strategies, basic challenges in supply chain management of e-commerce firms	9
	Total	**42**

11. **Suggested Books**

Unit No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011, ISBN-978-0273755869
2	Marketing Management, 14th ed., Philip Kotler , Kevin Lane Keller, Abraham Koshy and MithileswarJha, Pearson Education, New Delhi, 2013,(ISBN-10: 9788131767160)
3	Marketing, 14th ed., Etzel, Bruce J Walker, William J Stanton and Ajay Pandit, Mc Graw Hill Education, 2009, ISBN -9780070151567
4.	MKTG, Charles W Lamb, Joe F Hair, Carl NcDaniel and Dheeraj Sharma, Cengage Learning,2012, ISBN- 9788131517086
5.	Marketing Management, RajanSaxena, Tata Mc Graw Hill Education, 2005, ISBN-9780070599536

MG355 HUMAN RESOURCE MANAGEMENT

1. Subject Code : **MG355**   Course Title : **Human Resource Management**
2. Content Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE)(Hrs.): Theory: 3 Hrs   Practical 0
4. Relative Weightage   : CWS:25   PRS   MTE:25   ETE:50   PR
5. Credits   : 3
6. Semester   : Third (ME+AE+PE+CE+ENE+BT+MC+AP+PT)/ Fourth (COE+IT+SE+EC+ EE+EEE)
7. Subject Area   : OEC Management
8. Pre-requisite   : Nil
9. Objective   : To develop necessary understanding in design and execution of human resource strategies for the achievement of organization goals.

10. Details of Course :

Unit No.	Content	Contact hours
1.	**Basic concepts of management:** management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2.	**Introduction:** Concept, nature, scope, objectives and importance of HRM; Evolution of HRM; Environment of HRM; Personnel Management vs HRM. Acquisition of Human Resources: HR Planning; Job analysis – job description and job specification; recruitment – sources and process; selection process – tests and interviews; placement and induction. Job changes – transfers, promotions/demotions, separations.	9
3.	**Training and Development:** Concept and importance of training; types of training; methods of training; design of training programme; evaluation of training effectiveness; executive development – process and techniques; career planning and development.	8
4.	**Performance Appraisal:** Performance appraisal – concept and objectives; traditional and modern methods, limitations of performance appraisal methods.	8
5.	**Compensation and Maintenance:** Compensation: job evaluation – concept, process and significance; components of employee remuneration – base and supplementary; maintenance: overview of employee welfare, health and safety, social security.	9
Total		**42**

11. **Suggested Books**

S. No	Name of the book /Authors /Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011, ISBN-978-0273755869
2	**Human Resource Management, G. Dessler, B. Varkkey, Pearson prentice Hall, 2011, (ISBN – 978-81-317-5426-9)**
3	International HRM a cross cultural approach, T. Jackson, Sage publications, London, 2002, (ISBN – 0-7619-7404-0)

| 4 | HRM and Performance: Achievements and Challenges, D. E. Guest, J .Paauwe, P. Wright, John Wiley and sons, UK, 2013, (ISBN – 978-1-118-48261-2) |
| 5 | A Handbook of Human Resource Management Practice, M. Armstrong, Kogan Page Limited, UK, 2007 ,(ISBN – 978–0–7494–4631-4) |

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MG357 KNOWLEDGE AND TECHNOLOGY MANAGEMENT

1. Subject Code : **MG 357**   Course Title : **Knowledge and Technology Management**
2. Content Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs   Practical 0
4. Relative Weightage   : CWS:25   PRS   MTE:25   ETE:50   PR
5. Credits   : 3
6. Semester   : Third (ME+AE+PE+CE+ENE+BT+MC+AP+PT)/ Fourth   (COE+IT+SE+EC+ EE+EEE)
7. Subject Area   : OEC Management
8. Pre-requisite   : Nil
9. Objective   : Preparing the students to understand how the new age organizations are leveraging on the power of knowledge and technology. Acquiring the knowledge to address the issues faced by the corporate world for a deeper understanding.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1.	**Basic concepts of management**, management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2.	Introduction to Knowledge Management: Data, Information, Knowledge Management (KM), Knowledge Society, Knowledge Economy, Types of Knowledge, Tacit knowledge and explicit knowledge, Essential components of KM model Building Knowledge Assets: Various knowledge assets, Tools of Knowledge, Knowledge Audit, AAR (After Action Review), Analyzing current knowledge state.	9
3.	Creating Strategies for Success: KM strategy, Codification, Personalization, Knowledge Management Implementation,	9

	Generating a KM-specific vision, Integrating organizational and business goals with KM, Choosing the right KM techniques, Relevant case studies in this area.	
4.	Understanding Technology: Definition, Key concepts, Need for technology, History of technological developments, Role and importance of technology in 21st century, Recent developments in the field of technology.	8
5.	Technology-Management integration: Management as a concept, Technology management, Life cycle approach to technology management, Innovation, Creativity, Technology innovation process.	8
	Total	**42**

11. **Suggested Books**

S. No.	Name of Books /Authors/Publishers
1.	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,2011, ISBN-978-0273755869
2	Knowledge Management in Organizations: A Critical Introduction, Donald Hislop, Oxford University Press,2013, ISBN: 9780199691937.
3	The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation, IkujiroNonaka and Hirotaka Takeuchi, Oxford University Press,1995, ISBN: 0195092694.
4	Hitotsubashi on Knowledge Management (Hardcover), Hirotaka Takeuchi and IkujiroNonaka, John Wiley and Sons, 2004, ISBN: 0470820748.
5	Management of Technology: The Key to Competitiveness and Wealth Creation, Tarek Khalil and Ravi Shankar, McGraw Hill Education (India) Private Limited, 2nd Edition, 2012, ISBN: 9780070677371.

PE351 ADVANCED MACHINING PROCESS

1. Subject Code: **PE-351**   : Course Title: **Advanced Machining Process**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (Hrs.) : Theory: 3   Practical: 0
4. Relative Weight   : CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   : 3
6. Semester   : V
7. Subject Area   : OEC

8. Pre-requisite   :   NIL

9. Objective   :   To understand basic principles of various processes and their applications. State various parameters influencing the machining process.

10. Details of Course   :

Unit No.	Contents	Contact Hours
1	Introduction, need of advanced machining processes, hybrid processes, microelectro mechanical system, (MEMS), nano electromechanical systems(NEMS),Ultrasonic micro machining - mechanics of cutting, parametric analysis, process capabilities, applications.	7
2	Abrasive jet machining: Introduction, set ups, gas propulsion system, abrasivefeeder, machining chamber, AJM nozzle, abrasive parametric analysis, processscapabilities, applications, abrasive micro machining, Water jet machining:Introduction, process characteristics, process performance, applications, Abrasive Water jet machining: Abrasive	8
	finishing process: Working principle, parametric analysis, process variables, process performance and applications,	
3	Abrasive flow machining- Working principle, parametric analysis, process variables, process performance and applications, Magnetorheological abrasive flow finishing- Working principle, parametric analysis,process variables, process performance and applications, Magnetic float polishing,Magnetic abrasive finishing- Working principle, parametric analysis, processvariables, process performance and applications	10
4	Electro discharge machining (EDM): Introduction, Working principle, parametricanalysis, process variables, process characteristics, applications, hybrid processessuch as electro discharge grinding, diamond grinding, wire EDM, Electrodischargemicro grinding,	7
5	Laser beam machining- production of laser, working principle, types of laser, processcharacteristics and applications. Electron beam machining: Working principle,process parameter, process characteristics, and applications. Ion beam machining:Working principle, process parameter, process characteristics, and applications.	8
6	Plasma arc machining: Working principle, Plasma arc cutting system, applications.	2
Total		**42**

S. No.	Title, Author, Publisher and ISBN No.
1	Advanced machining process, Dr.V.K.Jain, Allied publisher, **ISBN**:978-81-7319-915-8.
2	Non traditional methods of manufacturing, Shan&Pandey, **ISBN**, 0070965536

PE353 SUPPLY CHAIN MANAGEMENT

1. Subject Code: **PE-353**   Course Title: **Supply Chain Management**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight   : CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   : 3
6. Semester   : V
7. Subject Area   : OEC
8. Pre-requisite   : NIL
9. Objective   : To understand the key considerations at the various stages involved in the supply of product in order to maintain the smooth flow from source to the point of consumption so that overall organizational performance may improve.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction:**Perspective of Supply Chain Management, Managing uncertainty, Key issue in supply chain management.	6
2	**Inventory Management and Risk Pooling:** Inventory management, Classification of inventory, Centralized versus Decentralized Warehousing and Risk pooling, Value of Information, Quantification of Bullwhip effect, Causes and remedies of Bullwhip effect.	8
3	**Resource planning:** Aggregate Production Planning- Chase and leveling strategies, MRP, MRP-II, Agile manufacturing Systems	6
4	**Procurement and Outsourcing strategies:**Introduction, outsourcing benefits and risks, Make/Buy decision, e-procurement, Vendor selection and quota allocation.	7
5	**Strategic Alliances:** Introduction, Third party logistics, Demand driven strategies, Distribution strategies- direct shipment, cross docking,	8

	transshipment, Supplier relationships management, Customer relationship management.	
6	**International Issues in Supply Chain Management:** Concepts in Globalization, Globalization forces, Risks and Advantages of International supply chains, Issues in International supply chain management, Regional differences in logistics.	7
	Total	**42**

11. **Suggested Books:**

S. No.	Title, Author, Publisher and ISBN No.
1.	Simchi-Levi, Kaminsky, Philip K. and 'Designing and Managing the Supply Chain: Concepts, Strategic and Case Studies', McGraw-Hill/Irwin, (ISBN, 10: 0072357568, 13: 978-0072357561).
2	Supply Chain Management by Chopra and Mendle, **ISBN**: 9780132743952
3	Supply Chain Management: Text and Cases by JannatSah.,**ISBN**-10: 8131715175.

PE355 WORK STUDY DESIGN

1. Subject Code : **PE-355**   Course Title : **Work Study Design**
2. Contact Hours   :   L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   :   Theory: 3 Practical: 0
4. Relative Weight   :   CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   :   3
6. Semester   :   V
7. Subject Area   :   OEC
8. Pre-requisite   :   NIL
9. Objective   :   To provide basic understanding to the students about the concept and significance of work study and ergonomics. To impart thorough knowledge to the students about various techniques of work-study for improving the productivity of an organization.
10. Details of Course   :

Unit No.	Contents	Contact Hrs
1	Productivity: Definition, reasons for low productivity, methods to improve productivity, Work-study and productivity	4

2	Human factor in work-study: Relationship of work-study man with management, supervisor & workers, qualities of a work-study man.	5
3	Method-study: Definition, objectives, step-by-step procedure, questioning techniques, charts and diagrams for recording data. Like outline process charts, flow process charts, multiple activity charts, two handed process chart, string diagram, travel chart, cycle graph, Chrono-cycle graph, therbligs, micro motion study and film analysis, Simo chart, principles of motion economy. Development and installation of new method..	9
4	Work-Measurement: Definition, various techniques of work-measurement work-sampling, stopwatch time study & its procedure, Job selection, Equipment and forms used for time study, rating, methods of rating, allowances and their types, standard time, numerical problems, predetermined - time standards and standard data techniques. Incentive: Meaning, objectives of an incentive plan, various types of incentive plans	9
5	Ergonomics: Introduction, history of development, man-machine system and its components. Introduction to structure of the body-features of the human body, stress and strain, metabolism, measure of physiological functions- workload and energy consumption, biomechanics, types of movements of body members, strength and endurance, speed of movements. NIOSH lifting equation, Lifting Index, Maximum acceptable Weights and Forces, Distal upper extremities risk factors, Strain Index, RULA, REBA.	8
6	Applied anthropometry - types, use, principles in application, design of work surfaces and seat design. Visual displays for static information, visual displays of dynamic information, auditory, tactual and olfactory displays and controls. Assessment of occupational exposure to noise, heat stress and dust .Effect of vibration/ noise, temperature, illumination and dust on human health and performance	7
Total		**42**

11. **Suggested Books:**

S. No.	Title, Author, Publisher and ISBN No.
1.	Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, **ISBN-10:** 8126522178, 2009.
2	Marvin E, Mundel& David L, "Motion & Time Study: Improving Productivity", Pearson Education,**ISBN-10:** 0136030440, 2000.

3	Benjamin E Niebel and FreivaldsAndris, "Methods Standards & Work Design", McGraw Hill,**ISBN-10**1259064840, 1997.
4	International Labour organization, "Work-study", Oxford and IBH publishing company Pvt. Ltd., N.Delhi, **ISBN-10** 8120406028, 2001

PE357 PRODUCT DESIGN & SIMULATION

1. Subject Code: **PE-357**   Course Title: **Product Design & Simulation**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0
4. Relative Weight   : CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   : 3
6. Semester   : V
7. Subject Area   : OEC
8. Pre-requisite   : NIL
9. Objective   : To allow students to develop the technical, analytical, and managerial skills necessary to perform the tasks successfully.
10. Details of Course   :

Unit No.	Content	Contact Hours
1	**Stages in design process:**Introduction to various stages of the design process: Formulation of problem, Generate alternatives, Evaluation, Guided Redesign. Case study.	6
2	**Product life cycle:**New product introduction: early introduction, increased product life. Life cycle management tool, System integration, QFD, House of quality, Pugh's method, Pahl and Beitz method. Case studies.	6
3	**Value engineering:**Introduction, nature and measurement of value. Value analysis, job plan. Creativity and techniques of creativity. Value analysis test. Case studies. **Material selection:**Materials in design. The evolution of engineering materials. Design tools and material data. Functional material, shape and process. Material selection strategy, attribute limits, selection process, common methods of material selection. Case studies.	6
4	**Concurrent/ reverse engineering:**Introduction, basic principles, components, benefits of concurrent engineering. Concept of	6

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	reengineering.**Process selection:** Introduction. Process classification: shaping, joining and finishing. Systematic process selection, Ranking, process cost. Computer – aided process selection.	
5	**Design for manufacture and assembly:**Design for Manufacture and Assembly (DFMA). Reasons for not implementing DFMA. Advantages of DFMA with case studies. Design features and requirements with regard to assembly, product Design for Manufacture in relation to any two manufacturing processes: machining and injection molding. Need, objectives.	8
6	**System Simulation**: Techniques of simulation, Monte Carlo method, Experimental nature ofsimulation, Numerical computation techniques, Continuous system models, Analog andHybrid simulation, Feedback systems, Computers in simulation studies, Simulation softwarepackages. **Simulation of Mechanical Systems**: Building of Simulation models, Simulation oftranslational and rotational mechanical systems, Simulation of hydraulic systems.	10
	Total	**42**

11. **Suggested Books:**

S. No.	Title, Author, Publisher and ISBN No.
1.	**Product Design and Development**, "Karl T. Ulrich, Steven D. Eppinger"Mc GrawHill. **ISBN:**9780072296471
2.	**Integrated Product and Process Development**, "John M. Usher, Utpal Roy and H. R. Parasaei. ISBN: 978-0-471-15597-3
3.	**Product Design for Manufacture and Assembly**, "G. Boothroyd, P. Dewhurst and W. Knight" MarceDaker. ISBN:978-1420089271
4.	**Engineering Design and Design for Manufacturing**: A structured approach, "John R. Dixon and CPoli" Field Stone Publishers, USA. ISBN: 9780964527201
5.	**Material Selection in Mechanical Design**, "M. F. Ashby"Elsevier. ISBN: 9780080419077

PE359 TOTAL LIFE CYCLE MANAGEMENT

1. Subject Code: **PE359**   Course Title: **Total Life Cycle Management**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   : Theory: 3 Practical: 0
4. Relative Weight   : CWS: 25   PRS: 0   MTE:25   ETE:50   PRE: 0
5. Credits   : 3

6.	Semester	:	V
7.	Subject Area	:	OEC
8.	Pre-requisite	:	NIL
9.	Objective	:	To familiarize the students with the concept of Total Life Cycle, management of old vehicles, applying life cycle thinking to define tradeoffs. This course also introduces to sustainability, use of renewable resources.
10.	Details of Course	:	

S. No.	Contents	Contact Hours
1	**Introduction :** Definition of Total Life Cycle (TLC) – Conceptof TLC - Life Cycle Impacts - Integrating Life Cycle Technologies- Products and Processes Within TLC - TLC Methodology- TLC Accessement Data to Complex Products – ResultantImprovement for Product	8
2	**Vehicles End of Life** : Design for End of Old VehicleManagement - Problems of Old Vehicles in EmergingMarkets - Recovery and Economic Feasibility of MaterialsSuch As Plastic, Rubber, Aluminium, Steel, etc.	8
3	**Trade-offs :** Applying Life Cycle Thinking to Define Trade offs Along the Supply, Manufacture - Use and End of Life Chain- Effects on the Customer - Expectation of the Customer -Evaluate Product Cost on Fuel Consumption, Emission,Durability, Environment and Health	10
4	**Sustainability:**What Is Sustainability - Use of RenewableResources - View to Design Horizon.	8
5	**Harmonization of Environmental Goals:** TLC for Emerging Vs Developed Markets - Rules and Regulations to Guide Designers - International Common Practices for End of LifeVehicles.	8
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors /Books / Publishers
1	Life Cycle Management Case Study of an Instrument Panel /SAE, 1997/
2	Accident Reconstruction: Automobiles, Tractor-semitrailers, Motorcycles, and Pedestrians /Society of Automotive Engineers, 1987 /0898834546, 9780898834543.

PE361 TOTAL QUALITY MANAGEMENT

1. Subject Code: **PE-361**   Course Title: **Total Quality Management**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (Hrs.)   : Theory : 3   Practical : 0
4. Relative Weight   : CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0
5. Credits   : 3
6. Semester   : V
7. Subject Area   : OEC
8. Pre-requisite   : NIL
9. Objective   : To understand the philosophy and core values of Total Quality Management (TQM); determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization;
10. Details of Course   :

Unit No.	Content	Contact Hours
1	**Introduction to Quality-** Definition of Quality- product, user, value, and manufacturing based perspectives, Dimensions of Quality, Quality Planning, Quality costs- optimization of quality costs, seven tools of quality control;Philosophies of Quality Gurus- Deming, Juran, Crosby, Feigenbaum, Ishikawa, Taguchi. Comparison of Quality Philosophies.	9
2	**Statistical Process Control-**Introduction to Quality characteristics-variables and attributes, Types and causes of variations, Control Charts for variables and attributes, Process capability.	8
3	**Acceptance Sampling-**Sampling process and lots formation; Advantages and applications of acceptance sampling; characteristics of O.C. Curve; Single, double, multiple, sequential sampling; ASN, ATI, AOQL, AOQ, AQL, LQL, Producer's and Consumer's risks.	7
4	**Six Sigma and ISO 9000:2000-** Principles of Six Sigma, Statistical basis, Tools and techniques, DMAIC principle, application of six sigma in manufacturing and service organizations, structure of ISO standards, Factors leading to ISO, Implementation and registration, Benefits of ISO.	6
5	**Life Testing-Reliability-**Life testing: objective, failure data analysis, MTTF, MTBF, hazard rate, exponential and Weibull models, system reliability-series, parallel and mixed configurations, Markov model.	6

6	**Reliability Design and Allocation-** Design for reliability, reliability improvement techniques, active redundancy and standby redundancy, K-out-of-N redundancy and maintenance policies.	6
	Total	**42**

11.   **Suggested Books:**

S. No.	Title, Author, Publisher and ISBN No.
1.	Evans JR,Lindsay WM, "The Management and Control of Quality", Cengage learning, India, **ISBN-10:** 8131501361, 2011
2	BediKanishka,"Quality Management",Oxford University Press India, **ISBN-10:** 0195677951, 2006
3	Besterfield,"Total Quality Management", Pearson Education, **ISBN-10:** 9332534454, 2015
4	Gryna FM, Chua RCH, Defeo JA, "Jurans Quality Planning and Analysis for Enterprise Quality", McGraw Hill Education (India) Private Limited, **ISBN-10:** 0070618488, 2006

PT361 HIGH PERFORMANCE POLYMERS

1. Subject Code: **PT361**   Course Title: **High Performance Polymers**
2. Contact Hours   : L: 03   T: 00   P: 00
3. Examination Duration (Hrs.) : Theory : 03   Practical: 00
4. Relative Weight   : CWS: 25 PRS: 00 MTE: 25 ETE: 50   PRE: 00
5. Credits   : 03
6. Semester   : ODD-V
7. Subject Area   : OEC
8. Pre-requisite   : NIL
9. Objective   : To impart knowledge about heat resistant polymers, liquid crystalline polymers, conducting and other special polymers.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	Heat resistant polymers: Requirements for heat resistance, Determination of heat resistance, Synthesis, Structure-property relationships, Applications of heat resistant polymers like polyamides, polyimides and its derivatives, polyquinolines, polyquinoxalines, PBT, PBO, PBI, PPS, PPO, PEEK, engineering plastic blends.	9

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2	Liquid crystalline polymers, Concept of liquid crystalline phase, Theories of liquid crystallinity, Characteristics of LC state and LCPs, Rheology of liquid crystalline polymers, Blends of LCPs, Self reinforced composites, Applications.	9
3	Conducting polymers, Conduction mechanism, semi-conductors and conducting polymers, Band theory, Doping of polymeric systems, Processing and testing of conducting polymers, Applications and recent advances in conducting polymers.	9
4	Synthesis and applications of photosensitive polymers, Curing reactions.	6
5	Polymers in specialty applications: Polymers in agricultural applications, Green houses, Mulches, Control release of agricultural chemicals, Seed coatings, Polymers in construction and building applications.	9

11.   **Suggested Books**

S. No.	Name of Books/Authors/Publisher
1	Encyclopedia of Polymer science and Engineering Vol.1-17/ J.I. Kroschwitz, 2007
2	Additive for coatings/ John Bieleman/ Wiley-VCH, 2000.
3	Fire Properties of Polymeric Composites Materials/ A.P. Mouritz, A G. Gibson/ Springer, 2006.
4	Modern Biopolymers science: Bridging the divide between fundamentals treatise and industrial application/S. Kasapis, I.T. Nortan, J.B. Ubbink/ Elsevier 2009

PT363 SEPARATION TECHNOLOGY

1. Subject Code: **PT363**   Course Title: **Separation Technology**
2. Contact Hours   :   L: 03   T: 00   P: 00
3. Examination Duration (Hrs.)   :   Theory: 03   Practical: 00
4. Relative Weight   :   CWS: 25 PRS: 00 MTE: 25 ETE: 50   PRE: 00
5. Credits   :   03
6. Semester   :   ODD-V
7. Subject Area   :   OEC
8. Pre-requisite   :   NIL
9. Objective   :
10. Details of Course

Unit No.	Contents	Contact Hours
1	Separation factors and its dependence on process variables, classification and characterization, thermodynamic analysis and energy utilization, kinetics and mass transport, Theory of cascades and its applications.	7
2	Membrane Separations, Merits and demerits, Commercial, pilot plant polarization of membrane processes and laboratory membrane permeators, Dialysis, Reverse osmosis, Ultrafiltration, Membrane operations, Design controlling factors.	7
3	Separation by Sorption Techniques, Types and choice of adsorbents, chromatographic techniques, Retention theory mechanism, Design controlling factors, ion exchange chromatography equipment and commercial processes, recent advances in sorption technology.	7
4	Ionic Separations: Theory, mechanism and equipments for electrophoresis, dielectrophoresis and electro dialysis, Controlling factors, Applications, Design considerations.	7
5	Thermal Separation: Thermal diffusion, Rate law, Theories of thermal diffusion for gas and liquid mixtures, Equipments design and applications, Zone melting, Equilibrium diagrams, Controlling factors, Apparatus and applications.	7
6	Other Techniques: Adductive crystallization, Molecular addition compounds, Clathrate compounds and adducts, Equipments, Applications, Economics and commercial processes. Foam Separation: Surface adsorption, Nature of foams, Apparatus, Applications and Controlling factors.	7

11.   **Suggested Books**

S. No.	Name of Books/Authors/Publisher
1	New Chemical Engineering Separation Techniques/ Schoen/ Wiley Interscience, New York, 1972.
2	Separation Processes/ C.J. King/ Tata McGraw Hill, New Delhi,1982.
3	Bioseparations – Principles and Techniques/ B. Sivasankar/ Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4	Separation process Principles/ Seader, Henley and Roper/ John Wiley & Sons 2010
5	Membrane Separation processes/ Kaushik Nath/ PHI , 2008.

PT365 NON-CONVENTIONAL ENERGY

1. Subject Code: **PT365**   Course Title: **Non-Conventional Energy**
2. Contact Hours   : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory : 03 Practical : 00
4. Relative Weight   : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits   : 03
6. Semester   : ODD-V
7. Subject Area   : OEC
8. Pre-requisite   : NIL
9. Objective   : To make student aware about the fundamentals and applications of non-conventional energy.
10. Details of Course   :

Unit No.	Contents	Contact Hours
1	Renewable and non-renewable energy sources, trends in energy consumption, Global and National scenarios, Prospects of renewable energy sources, Energy Management.	6
2	Solar Energy: Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, measurement of solar radiation, flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, Storage of solar energy-thermal storage, Photo voltaics - solar cells & its applications.	6
3	Wind Energy: Basic system principles, Assessment of wind available, Design principles, Manufactured designs, Sizing and storage of energy, System efficiency, Overview of wind industry.	4
4	Energy from Biomass: Calorific value of Biomass samples, Pyrolysis, Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas.	6
5	Geothermal Energy: Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages, and application of geothermal energy.	4

6	Ocean Energy: Ocean Thermal Electric Conversion systems like open cycle, closed cycle, Hybrid cycle. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.	4
7	Magnetohydrdynamic Power Generation: Principle of MHD power generation, MHD system, Design problems and developments, gas conductivity, materials for MHD generators and future prospects.	4
8	Fuel Cells: Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, applications of fuel cells.	4
9	Hydrogen Energy: Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles.	4

11.   **Suggested Books**

S. No.	Name of Books/Authors/Publisher
1	Principles of Sustainable Energy Systems, Second Edition/ Frank Kreith, Susan Krumdieck/ CRC Press, 2013**.**
2	Non-conventional energy sources/ G.D. Rai/ Khanna Publishers, 2004.
3	Solar Energy: Fundamentals and Applications/ H.P. Garg & Jai Prakash/ Tata McGraw Hill, 2000
4	Solar Engineering of Thermal Processes/ Duffic and Beckman/ John Wiley, 2013
5	Non Conventional Energy Resources/ Saeed and Sharma/ S.K. Kataria& Sons ,2013

PT367 POLYMER WASTE MANAGEMENT

1. Subject Code: **PT367**   Course Title: **Polymer Waste Management**
2. Contact Hours   :   L: 03   T: 00   P: 00
3. Examination Duration (Hrs.) :   Theory : 03   Practical : 00
4. Relative Weight   :   CWS: 25 PRS: 00 MTE: 25 ETE: 50   PRE: 00
5. Credits   :   03
6. Semester   :   ODD-V
7. Subject Area   :   OEC
8. Pre-requisite   :   NIL
9. Objective   :   To impart knowledge about polymer waste and their management.

10. Details of Course :

Unit No.	Contents	Contact Hours
1	Polymer and Plastics Waste: Definition of plastics waste and the associated problems, Identification, collection methods and separation. Integrated waste management – source reduction, recycling, energy recovering process through thermal and biological destruction, Land filling and composting.	8
2	Plastics waste management: Source reduction, reuse, repair, recycling, and incineration with examples. Plastics recycling: Classification, Code of practice, Primary, secondary, territory and quaternary recycling with examples, Waste plastics as fillers.	8
3	Recycling and degradation of plastics: Recycling and sustainability correlation, Basic principles and recovery, recycling and resource conservation.	9
4	Recycling of plastics by surface refurbishing, Application of a coating, polishing, Plastics, Environmental and Thermal ageing, Chemical degradation, Wear and erosion, Biodegradable plastics – an overview.	9
5	Environmental issues, policies and legislation in India.	8

11.   **Suggested Books**

S. No.	Name of Books/Authors/Publisher
1	Plastics Recycling – Products and Processes/ Ehrig (Ed.)/ Hanser Publication, 1993
2	Recycling and recovery of plastics/ Brandrup/ Hanser Publishers, New York, 1996
3	Handbook of Plastics Recycling/ By Francesco La Mantia/ Rapra Tech Ltd , 2002
4	Introduction to Plastics Recycling/ By VannessaGoodship/ Rapra Tech Ltd ,2007

PT369 NANOTECHNOLOGY IN POLYMERS

1. Subject Code: **PT369**   Course Title: **Nanotechnology in Polymers**
2. Contact Hours   : L: 03   T: 00   P: 00
3. Examination Duration (Hrs.) : Theory : 03   Practical : 00
4. Relative Weight   : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits   : 03
6. Semester   : ODD-V
7. Subject Area   : OEC

8. Pre-requisite : NIL
9. Objective : To make student aware about the applications of nanopolymers in various fields.
10. Details of Course :

S. No.	Contents	Contact Hours
1	Concepts of nanotechnology, Time and length scale in structures, Nanosystems, Dimensionality and size dependent phenomena, Surface to volume ratio-Fraction of surface atoms, Surface energy and surface stress, surface defects, Properties at nanoscale (optical, mechanical, electronic, and magnetic).	8
2	Nano-materials, Classification based on dimensionality, Quantum Dots, Wells and Wires, Carbon-based nano-materials, Metal based nano-materials, Nanocomposites, Nanopolymers, Nanoglasses, Nanoceramics, Biological nanomaterials.	8
3	Synthesis of nanopolymers, Chemical Methods, Metal Nanocrystals by Reduction, Solvothermal Synthesis, Photochemical Synthesis, Sonochemical Routes, Chemical Vapor Deposition, Metal Oxide - Chemical Vapor Deposition, Physical Methods such as ball Milling, electrodeposition, spray pyrolysis, flame pyrolysis, DC/RF magnetron sputtering, Molecular beam epitaxy.	9
4	Nanofabrication, Photolithography and its limitations, Electron beam lithography, Nanoimprint, Soft lithography patterning, Characterization with Field Emission Scanning Electron Microscopy, Environmental Scanning Electron Microscopy, High Resolution Transmission Electron Microscope, Scanning Tunneling Microscope, Surface enhanced Raman spectroscopy, X-ray Photoelectron Spectroscopy, Auger electron spectroscopy, Rutherford back scattering spectroscopy.	9
5	Applications of nanomaterials, Solar energy conversion and catalysis, Molecular electronics and printed electronics, Nanoelectronics, Polymers with aspecial architecture, Applications in displays and other devices, Nanomaterials for data storage, Photonics, Plasmonics, Nanomedicine, Nanobiotechnology and Nanotoxicology.	8

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Organic and Inorganic Nanostructures/ Nabok/ Artech House, 2005.
2	Nanoscience: Nanotechnologies and Nanophysics/ Dupas, Houdy, Lahmani/ Springer-Verlag Berlin Heidelberg ,2007
3	Nanostructured Materials and Nanotechnology/ H.S. Nalwa/ Academic Press , 2002
4	A Textbook of Nanoscience and Nanotechnology/ Pradeep/ Tata McGraw Hill Education Pvt. Ltd. , 2012

PT371 APPLICATIONS OF POLYMER BLENDS AND COMPOSITE

1. Subject Code: **PT371**　　　　　　Course Title: **Applications of Polymer Blends and Composite**

2. Contact Hours　　　　　　　: L: 03　　T: 00　　P: 00
3. Examination Duration (Hrs.)　: Theory: 03　　　Practical: 00
4. Relative Weight　　　　　　: CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits　　　　　　　　　: 03
6. Semester　　　　　　　　: ODD-V
7. Subject Area　　　　　　　: OEC
8. Pre-requisite　　　　　　　: NIL
9. Objective　　　　　　　　: To make student aware about the applications of polymers, blends and composites.
10. Details of Course　　　　　:

Unit No.	Contents	Contact Hours
1	Concepts of polymer blends, Advantages of blends over conventional polymers, Significance of polymer blend technology, Different steps involved in designing of a blend, Different methods of blending, Characterization of polymer blends.	8
2	Compatibilization and Phase Morphology, Role of compatibilizers in blend technology, techniques of compatibilization, Phase structure development in polymer blends, Factors affecting morphology of polymer blends, Properties of polymer blends.	8
3	Reinforcements, Properties and applications of Glass, Carbon, Kevlar, polyethylene, boron, ceramic and natural fibers. Concepts of matrix material, Thermoset matrix materials like - epoxy, polyester, vinyl	9

	esters, phenolic resin, polyimides, Thermoplastic matrix materials like - polyolefins, polyether ether ketones, polyphenylene sulfide, thermoplastic polyimides.	
4	Concept of composites, particulate and fibrous composites, Properties of composites, Fabrication of continuous and short fiber composites and particulate composites, mechanical and physical properties	9
5	Applications of blends and composites for civil, aerospace, automobiles etc	8

11.   **Suggested Books**

S. No.	Name of Books/Authors/Publisher
1	Fibre Reinforced composites/ P. K. Malik/ Marcel Deckar, 1988.
2	Composites Manufacturing: Materials, Product, and Process Engineering/ S.K. Mujumdar/ CRC press ,2002
3	Fibre-glass Reinforced Plastics/ N. P. Cheremisinoff (Ed)/ Noyce Pub, 1988.
4	Design Data for Reinforced Plastics/ N. L. Hancex, R. M. Mayer/ Chapman Hall, 1994.
5	Reinforced Plastics: Properties and Applications/ Raymond Seymour/ The Materials Information Society, 1991.

IT351 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

NAME OF DEPTT: Information Technology

1. Subject Code : **IT351** Course Title : **Artificial Intelligence and Machine Learning**
2. Contact Hours : L: 3   T: 0   P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs   Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5. Credits : 3
6. Semester : ODD
7. Subject Area : OEC
8. Pre-requisite : Discrete Mathematics
9. Objective : The student should be able to understand the different supervised, unsupervised and reinforcement learning algorithms and choose the appropriate machine learning tool for different real world examples.

10. Details of Course   :

S.No.	Contents	Contact Hours
1.	**Introduction** to Artificial Intelligence and Machine learning, State Space representation of problems, Concept of Search, overview of different tasks: classification, regression, clustering, control, Concept learning.	6
2.	**Heuristic Search Techniques:** Generate and Test, Hill Climbing, Best-first search, Branch and bound, A* algorithm, Game playing.	6
3.	**Knowledge Representation:**Propositional logic, Predicate Logic, semantic nets, frames	8
4.	**Supervised Learning:** Decision trees, nearest neighbors, linear classifiers and kernels, neural networks, linear regression; Support Vector Machines.	8
5.	**Unsupervised Learning:** Clustering, Expectation Maximization, Dimensionality Reduction, Feature Selection, PCA, factor analysis, manifold learning.	8
6.	**Applications &Research Topics**: Applications in the fields of web and data mining, text recognition, speech recognition	6
	TOTAL	**42**

11.   **Suggested Books**

S.No.	Name of Books / Authors/ Publishers	Year of Publication/Reprint
Text Book		
1.	Artificial Intelligence by Elaine Rich, K. Knight, McGrawHill	2009
1.	Introduction to Machine Learning, Alpaydin, E., MIT Press, 2004	
2.	Machine Learning, Tom Mitchell, McGraw Hill, 1997.	1997
3.	Elements of Machine Learning, Pat Langley Morgan Kaufmann Publishers, Inc. 1995. ISBN 1-55860-301-8	1995
Reference Book		
4.	The elements of statistical learning, Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. Vol. 1. Springer, Berlin: Springer series in statistics, 2001.	2001

5.	Machine Learning: A probabilistic approach, by David Barber.	2006
6	Pattern recognition and machine learning by Christopher Bishop, Springer Verlag, 2006	2006

IT353 DATA STRUCTURES AND ALGORITHMS

NAME OF DEPTT : Information Technology
1. Subject Code : **IT353**   Course Title : **Data Structures and Algorithms**
2. Contact Hours : L: 3   T: 0   P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs   Practical 0
4. Relative Weightage : CWS 25   PRS 0   MTE 25   ETE 50   PR 0
5. Credits : 3
6. Semester : ODD
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : The objective of the course is to familiarize students with basic data structures and their use in fundamental algorithms.
10. Details of Course :

S.No.	Contents	Contact Hours
1.	**Introduction:** Introduction to Algorithmic, Complexity- Time-Space Trade off. Introduction to C programming through Arrays, Stacks, Queues and Linked lists.	8
2.	**Trees:** Basic Terminology, Traversals, Binary search trees, optimal and average BST's. 2-4 trees, Applications of Binary search Trees, Complete Binary trees, Extended binary trees.	7
3.	**Introduction to algorithms:** Concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Growth of Functions, Master's Theorem,**Searching and Searching:** Linear Search, Binary search, Insertion Sort, Quick sort, Merge sort, Heap sort, Radix Sort.	9
4.	**Graphs:** Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Representation of graphs, Breadth first search and connected components. Depth first search in directed and undirected graphs and strongly connected components.	8

5.	**Spanning trees:** Prim's and Kruskal's algorithm, union-find data structure. Dijkstra's algorithm for shortest paths, shortest path tree. Directed acyclic graphs: topological sort and longest path.**Dynamic programming**: Principles of dynamic programming. Applications: Matrix multiplication, Travelling salesman Problem.	10
	Total	**42**

11. **Suggested Books**

S.No.	Name of Books / Authors/ Publishers	Year of Publication/Reprint
Text Books:		
1.	Horowitz and Sahni, "Fundamentals of Data structures", Galgotia publications 1983	
2.	Tannenbaum, "Data Structures", PHI 2007(Fifth Impression)	
3.	T .H . Cormen, C . E . Leiserson, R .L . Rivest "Introduction to Algorithms", 3rd Ed., PHI. 2011 (reprint)	
4.	E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," Galgotia Publication	
Reference Books		
1.	R.L. Kruse, B.P. Leary, C.L. Tondo, "Data structure and program design in C", PHI 2009(Fourth Impression)	
2.	Aho ,Ullman "Principles of Algorithms "	

IT355 COMMUNICATION AND COMPUTING TECHNOLOGY

NAME OF DEPTT : Information Technology
1. Subject Code : **IT355**   Course Title : **Communication and Computing Technology**
2. Contact Hours : L: 3   T: 0   P: 0
3. Examination Duration (ETE) (Hrs.) : Theory   3 Hrs   Practical 0
4. Relative Weightage : CWS 25   PRS 0   MTE 25   ETE 50   PR 0
5. Credits : 3
6. Semester : ODD
7. Subject Area : OEC
8. Pre-requisite : Operating systems, Algorithm Design and Analysis and data structures

9. Objective   : To introduce the concept of Communications in Computer networks

10. Details of Course   :

S.No.	Contents	Contact Hours
1.	**Introduction** to Goals and Applications of Networks, Network structure and architecture, The TCP/IP reference model, services, Network Topology.	6
2.	**Data Link Layer and Medium Access sub layer** - Channel Allocations, LAN protocols -ALOHA protocols - Overview of IEEE standards - FDDI. - Elementary Data Link Protocols, Sliding Window protocols.	6
3.	**Network Layer**: Routing, Congestion control, Internetworking -TCP / IP, IP packet, IP address, IPv6 and Mobile IP.	8
4.	**Transport Layer:** Design issues, TCP and UDP, connection management, Congestion control, Leaky bucket, Token bucket algorithm. QoS.	8
5.	**Application Layer:** File Transfer, Access and Management, Electronic mail, Virtual Terminals, Internet and Public Networks, Firewalls	6
6.	**Information and Web security**: IP Security, Architecture, Authentication header, Encapsulating security payloads, combining security associations, Secure Socket Layer(SSL) and transport layer security, TSP, Secure Electronic Transaction (SET), Electronic money.	8
	TOTAL	**42**

11.   **Suggested Books**

S.No.	Name of Books / Authors/ Publishers	Year of Publication/Reprint
Text Book		
1.	S. Tananbaum, "Computer Networks", 3rd Ed, PHI	1999
2.	U. Black, "Computer Networks-Protocols, Standards and Interfaces", PHI	1996
3.	W. Stallings, "Computer Communication Networks", PHI	1999

3.	Data Communications and Networking, Behrouz A. Forouzan 5/e	2013
Reference Book		
4.	William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy.	2001
5.	Behrouz A. Forouzan, "Cryptography and Network Security", TMH.	2006

IT357 INTERNET AND WEB PROGRAMMING

NAME OF DEPTT   : Information Technology
1. Subject Code : **IT357**   Course Title : **Internet and Web Programming**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE) (Hrs.): Theory   3 Hrs   Practical 0
4. Relative Weightage   : CWS 25   PRS 0   MTE 25   ETE 50   PR   0
5. Credits   : 3
6. Semester   : ODD
7. Subject Area   : OEC
8. Pre-requisite   : Nil
9. Objective   : To introduce the concept of internet and web programming
10. Details of Course   :

S.No.	Contents	Contact Hours
1.	**Internet and WWW:** Internet basic, Introduction to internet and its applications, E- mail, telnet, FTP, e-commerce, video conferencing, e-business. Internet service providers, domain name server, internet address World Wide Web (WWW): World Wide Web and its evolution, uniform resource locator (URL), browsers - internet explorer, netscape navigator, opera, firefox, chrome, mozilla. Search engine, web saver - apache, IIS, proxy server, HTTP protocol.	6
2.	**WEBSITES BASIC ANDWEB 2.0**: Web 2.0: Basics-RIA Rich Internet Applications - Collaborations tools - Understanding websites and web servers: Understanding Internet – Difference between websites and web server- Internet technologies Overview – Understanding the difference between internet and intranet; HTML and CSS: HTML 5.0, XHTML, CSS 3.	6
3.	**E-MAIL SECURITY & FIREWALLS** : PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls - Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-	8

	Commerce Transactions, intellectual property: copyright, patents, trademarks, cyber laws	
4.	**SERVELETS AND JSP**: JSP Technology Introduction-JSP and Servelets- Running JSP Applications Basic JSP- JavaBeans Classes and JSP-Tag Libraries and Files- Support for the Model- View- Controller Paradigm- Case Study- Related Technologies.	8
5.	**XML**: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application.XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT	6
6.	**PHP:** Starting to script on server side, Arrays, function and forms, advance PHP, Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP my admin and database bugs.	8
	TOTAL	**42**

11. **Suggested Books**

S.No.	Name of Books / Authors/ Publishers	Year of Publication/Reprint
Text Books		
1.	Internet and Web Technologies by Raj Kamal, Tata McGraw Hill edition. (ISBN: 9780070472969)	2002
2.	An Introduction to Search Engines and Web Navigation, Mark Levene, Pearson Education. (ISBN: 978047052684)	2010
3.	Modeling the Internet and the Web,PierreBaldi,PaoloFrasconi, Padhraic Smyth, John Wiley and Sons Ltd. (ISBN: 978-0-470-84906-4)	2003
Reference Books		
4.	HTML: A Beginner's Guide by Wendy Willard, Tata McGraw-Hill (ISBN: 9780070677234)	2009
5.	PHP and MySQL for Dynamic Web Sites, Ullman, Larry, Peachpit Press.1 (ISBN: 978-0-321-78407-0)	2012

IT359 JAVA PROGRAMMING

NAME OF DEPTT : Information Technology
1. Subject Code : **IT359**   Course Title : **Java Programming**
2. Contact Hours   : L: 3   T: 0   P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs   Practical 0
4. Relative Weightage   : CWS 25   PRS 0   MTE 25   ETE 50   PR 0
5. Credits   : 3
6. Semester   : ODD
7. Subject Area   : OEC
8. Pre-requisite   : Nil
9. Objective   : To introduce the concept of java programming
10. Details of Course   :

S.No.	Contents	Contact Hours
1.	**Introduction to Java**: Programming language Types and Paradigms, Computer Programming Hierarchy, How Computer Architecture Affects a Language? , Why Java?, Flavors of Java, Java Designing Goal, Role of Java Programmer in Industry, Features of Java Language, JVM – The heart of Java , Java's Magic Byte code.	6
2.	**The Java Environment:** Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions. Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Datatypes, Operators Assignments.	6
3.	**Object Oriented Programming**: Class Fundamentals , Object & Object reference, Object Life time & Garbage Collection, Creating and Operating Objects , Constructor & initialization code block, Access Control, Modifiers, methods Nested , Inner Class &Anonymous Classes, Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism, Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method.	8
4.	**Extending Classes and Inheritance**: Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance, Overriding Super Class Methods, Use of "super", Polymorphism in inheritance, Type Compatibility and Conversion Implementing interfaces.	8

5.	**Package**: Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining Package, CLASSPATH Setting for Packages, Making JAR Files for Library Packages Import and Static Import Naming Convention For Packages.	6
6.	**GUI Programming**: Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects, Collection Types, Sets , Sequence, Map, Understanding Hashing, Use of Array List & Vector.	8
	TOTAL	**42**

11. **Suggested Books**

S.No.	Name of Books / Authors/ Publishers	Year of Publication/Reprint
	Text Books	
1.	The Complete Reference Java,, Herbert Schildt, ISBN: 978-0-07163177-8, Publisher: McGraw Hill	7th Edition
2.	Thinking in Java, Bruce Eckel, ISBN: 0-13-187248-6, Publisher: Prentice Hal	4th Edition
3.	The Java Programming Languages,, Ken Arnold, ISBN-13:978-032134980, Publisher: Sun	4th Edition
4.	Java in Nutshell,, Benjamin,ISBN: 9781449371296, Publisher: O'Reilly Media, Inc.	6th Edition

1. Subject Code: **CE351**   Course Title: **Geoinformatics and its Applications**
2. Contact Hours   :   L: 3   T: 0   P: 2
3. Examination Duration (Hrs.)   :   Theory : 3   Practical: 0
4. Objective   :   To familiarize the students with the concepts of the subject and its related applications in Civil Engg and allied fields.
5. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction to Geoinformatics, Remote Sensing, GIS and GPS:** Definitions of Geoinformatics, Remote Sensing, GIS and GPS, sources of energy, electromagnetic spectrum, electromagnetic radiation, reflection, transmission and absorption, Platforms and sensors, active and passive sensors, PAN, Multi and hyperspectral remote sensing data acquisition systems	8
2	**Maps, Datums, Projections Systems and spatial data analysis** - Plane and Geodetic surveying, Classification of surveys, Basic Principles of Surveying, Type of maps, scales and uses, plotting accuracy, map sheet numbering. Datums, coordinates and map projection systems. Data retrieval and querying, measurements in GIS, classification, accuracy.	8
3	**Optical, Thermal and Microwave Remote Sensing**. Brief review of Optical, thermal and microwave remote sensing, their utility, merit and demerits, Interaction of EMR with atmosphere, scattering, refraction, absorption, transmission, atmospheric windows, interaction of EMR with earth surface, spectral characteristics of remote sensing data,	8
4	**Basic Photogrammetry and Digital Image Processing:** Photogrammetry, aerial and terrestrial, applications of photogrammetry, types and geometry of aerial photograph, flying height and scale, relief (elevation) displacement. Digital image, digital image processing introduction to, preprocessing, enhancement, classification, visual image interpretation, Introduction to software - MATLAB, ENVI, ERDAS, AutoCAD etc	10
5	**Applications of Geoinformatics, Remote Sensing, GIS and GPS:** Land cover classification survey and Mapping, Digital elevation model (DEM), Introduction to SAR data, Applicationsin Disaster management, geology, forest security and military projects.	8
	Total Contact Hrs	**42 Hrs 14 weeks**

11. **Suggested Books:**

S.N.	Name of Books/ Authors	
1	Agarwal, C.S. and Garg, P.K., "Remote Sensing in Natural Resources Monitoring and Management", Wheeler Publishing House (ISBN 6-74-268173-4)	2000
2	Bossler, J.D., "Manual of Geospatial Science and Technology", Taylor and Francis. (ISBN 0-74-68914355-7)	2002
3	Burrough, P.A. and McDonnell, R.A., "Principles of Geographic Information System", Oxford University Press. (ISBN 0-07-985256-4)	2000
4	Chandra, A.M. and Ghosh, S.K., "Remote Sensing and Geographical Information Systems", Alpha Science. (ISBN 0-07-8452567-1)	2005
5	Gopi, S., "Global Positioning System: Principles and Applications", Tata McGraw Hill. (ISBN 0-07-7691528-1)	2005