Himachal Pradesh Technical University, Hamirpur (H.P.)

CURRICULUM(CBCS)

AUTOMOBILE ENGINEERING
(3rd to 8th Semester)

Teaching and Examination Scheme

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H.P. Technical University
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SCHEME OF TEACHING AND EXAMINATION
B.TECH AUTOMOBILE ENGINEERING

SEMESTER – III

S. N.	Cat.	Course Code	Subject	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I.A Marks	ESE Marks	Total Marks
1	FC	MA-301	Probability and Statistics	2	2	0	3	40	60	100
2	FC	HS – 305	Industrial Economics and Management	3	0	0	3	40	60	100
3	PC	AU-301	Elements of automobile Engineering	3	1	0	4	40	60	100
4	PC	ME-301	Strength of Material-I	3	1	0	4	40	60	100
5	PC	ME-303	Engineering Thermodynamics	3	0	0	3	40	60	100
6	PC	ME-304	Machine Drawing	2	0	3	3	40	60	100
7	OE	-	Open Elective-I	2	0	0	2	40	60	100
Labs:										
1	PC	ME-305	Strength of Material Lab	0	0	2	1	30	20	50
2	PC	AU-302	Elements of automobile Engineering Lab	0	0	2	1	30	20	50
3	MC	ME-307	Computer Aided Design(CAD) Lab-I	0	0	3	2	30	20	50
			Total	16	4	10	24+2			

S. N.	Cat.	Subject Code	Title	Teaching Hours Per Weak			Credits	Examination		
OPEN ELECTIVE – I										
				L	T	P/D		I.A Marks	ESE Marks	Total Marks
1	OE	HS-306	Sociology & Elements of IndianHistory for Engineers	2	0	0	2	40	60	100
2	OE	HS-307	German Language - I	2	0	0	2	40	60	100
3	OE	HS-308	French Language - I	2	0	0	2	40	60	100

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'SCHEME OF TEACHING AND EXAMINATION
B.TECH AUTOMOBILE ENGINEERING

SEMESTER – IV

S. N.	Cat.	Course Code	Subject	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I.A Marks	ESE Marks	Total Marks
1	FC	MA-401	Optimization and Calculus of Variations	2	2	0	3	40	60	100
2	FC	HS-409	Human Values and Professional Ethics	2	2	0	3	40	60	100
3	PC	AU-401	Auto fuel and Lubricants	3	0	0	3	40	60	100
4	PC	AU-402	Fluid Mechanics & Fluid Machines	3	1	0	4	40	60	100
5	PC	ME-402	Strength of Material-II	3	1	0	4	40	60	100
6	PC	ME-403	I.C Engines	3	0	0	3	40	60	100
7	OE	-	Open Elective-II	2	0	0	2	40	60	100
Labs:										
1	PC	ME-405	I.C. Engine Lab	0	0	2	1	30	20	50
1	PC	AU-403	Auto fuel and Lubricants lab	0	0	2	1	30	20	50
3	MC	AU-404	Fluid Mechanics & Fluid Machines Lab.	0	0	3	2	30	20	50
			Total	16	6	7	24+2			

OPEN ELECTIVE – II										
S. N.	Cat.	Subject Code	Title	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I.A Marks	ESE Marks	Total Marks
1	OE	HS-410	Law for Engineers	2	0	0	2	40	60	100
2	OE	HS-411	German Language – II	2	0	0	2	40	60	100
3	OE	HS-412	French Language – II	2	0	0	2	40	60	100

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SCHEME OF TEACHING AND EXAMINATION
B.TECH AUTOMOBILE ENGINEERING

SEMESTER – V

S. N.	Categ.	Course Code	Subject	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I.A Marks	ESE Marks	Total Marks
1	PC	AU-501	Automotive Electricals & Electronics	3	0	0	3	40	60	100
2	PC	AU-502	Computer Aided Design(CAD)	2	2	0	3	40	60	100
3	PC	ME-501	Kinematics of Machines	2	2	0	3	40	60	100
4	PC	ME-503	Heat Transfer	3	1	0	4	40	60	100
5	PC	ME-504	Machine Design-I	3	1	0	4	40	60	100
6	PC	ME-506	Materials Technology	3	0	0	3	40	60	100
7	OE		Open Elective-III	2	0	0	2	40	60	100
Labs:										
1	MC	AU-511	CAD Lab-II	0	0	3	2	30	20	50
2	PC	AU-512	Automotive Electricals & Electronics lab	0	0	2	1	30	20	50
3	PC	ME-513	Heat Transfer Lab	0	0	2	1	30	20	50
			Total	16	6	7	24+2			

OPEN ELECTIVE – III

S. N.	Categ.	Subject Code	Title	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I.A Marks	ESE Marks	Total Marks
1	OE	ME-508	Robotics	2	0	0	2	40	60	100
2	OE	ME-509	Automobile Technology	2	0	0	2	40	60	100
3	OE	ME-510	Value Engineering	2	0	0	2	40	60	100

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SCHEME OF TEACHING AND EXAMINATION
B.TECH AUTOMOBILE ENGINEERING

SEMESTER – VI

S. N.	Categ.	Course Code	Subject	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I. A Marks	ESE Marks	Total Marks
1	PC	AU-601	Computer Aided Manufacturing CAM)	3	1	0	4	40	60	100
	PC	AU-602	Manufacturing Processes	2	2	0	3	40	60	100
2	PC	ME-602	Measurement and Control	3	0	0	3	40	60	100
3	PC	ME-603	Machine Design-II	3	1	0	4	40	60	100
4	PC	ME-604	Operation research	2	2	0	3	40	60	100
5	PC	ME-606	Dynamics Of Machinery	3	0	0	3	40	60	100
7	PE		Programme Elective-I	3	0	0	3	40	60	100
Labs:										
1	PC	AU-611	CAM Lab	0	0	2	1	30	20	50
2	PC	ME-612	Theory of Machine Lab	0	0	2	1	30	20	50
3	MC	ME-613	Seminar	0	0	3	2	50	50	100
			Total	16	6	7	24+3			

PROGRAM ELECTIVE – I

S. N.	Categ.	Subject Code	Title	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I.A Marks	ESE Marks	Total Marks
1	PE	AU-608	Automotive Air Conditioning	3	0	0	3	40	60	100
2	PE	AU-609	Combustion Engineering	3	0	0	3	40	60	100
3	PE	AU-610	Marketing and Sales Management	3	0	0	3	40	60	100

Industrial /Practical Training after VI Semester of six weeks duration.

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SCHEME OF TEACHING AND EXAMINATION
B.TECH AUTOMOBILE ENGINEERING

SEMESTER – VII

S. N.	Categ.	Course Code	Subject	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I. A Marks	ESE Marks	Total Marks
1.	PC	AU-701	Automotive Pollution & Control	3	0	0	3	40	60	100
2.	PC	ME-701	Industrial automation and Robotics	3	0	0	3	40	60	100
3	PC	ME-702	Refrigeration & Air Conditioning	3	1	0	4	40	60	100
4	PC	ME-704	Industrial Engineering & Production Management	2	2	0	3	40	60	100
5	PE		Programme Elective-II	3	0	0	3	40	60	100
Labs:										
1	MC	AU-711	Project Work -I	0	0	4	2	50	50	100
2	MC	ME-712	Automation and Robotics Lab	0	0	3	2	30	20	50
3	PC	AU-713	Industrial /Practical Training(Viva-Voce)	0	0	0	2	50	50	100
4	PC	AU-714	Automotive Pollution & Control Lab.	0	0	2	1	30	20	2
			Total	11	3	9	20+3			

PROGRAM ELECTIVE – II										
S. N.	Categ.	Subject Code	Title	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I.A Marks	ESE Marks	Total Marks
1	PE	AU-708	Tractor And Farm Equipments	3	0	0	3	40	60	100
2	PE	AU-709	Hybrid Vehicles	3	0	0	3	40	60	100
3	PE	AU-710	Motor Vehicle And Environment Protection	3	0	0	3	40	60	100

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SCHEME OF TEACHING AND EXAMINATION
B.TECH AUTOMOBILE ENGINEERING

SEMESTER – VIII

S. N.	Categ.	Course Code	Subject	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I. A Marks	ESE Marks	Total Marks
1	PE		Programme Elective - III	3	0	0	3	40	60	100
2	PE		Programme Elective - IV	3	0	0	3	40	60	100
3	MC	AU-807	Project Work - II	0	0	16	8	50	50	100
			Total	6	0	16	8+6			
OR										
4	MC	AU-808	Industrial Project	0	0	16	8	50	50	100
			Total	0	0	24	8			

PROGRAM ELECTIVE – III										
S. N.	Categ.	Subject Code	Title	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I.A Marks	ESE Marks	Total Marks
1	PE	AU-801	Vehicle Body Engineering	3	0	0	3	40	60	100
2	PE	AU-802	Entrepreneurship Development	3	0	0	3	40	60	100
3	PE	AU-803	Flexible Manufacturing System	3	0	0	3	40	60	100

PROGRAM ELECTIVE – IV										
S. N.	Categ.	Subject Code	Title	Teaching Hours Per Weak			Credits	Examination		
				L	T	P/D		I.A Marks	ESE Marks	Total Marks
1	PE	AU-804	Industrial Safety and Enviroment	3	0	0	3	40	60	100
2	PE	AU-805	Vehicles Design And Data Characteristics	3	0	0	3	40	60	100
3	PE	AU-806	Precision Engineering	3	0	0	3	40	60	100

Note: Industrial Project of Four months duration is to be carried out by the student exclusively in industry under the joint supervision of faculty advisers from institution as well as from the industry.

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MA 301: PROBABILITY AND STATISTICS

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	2	0	3	40	60	100	3 hrs

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Probability and Random Variables:** Introduction, Basic concepts–Sample space, Events, Counting sample space, Conditional Probability and Independence, Permutations and Combinations, Rules of Probability, Bayes' Theorem. Random Variables – Concept of Random Variable, Percentiles, Probability Distributions – Discrete & Continuous, Mean, Variance and Covariance of Random Variables, Chebychev's inequality.	6
II	**Standard Probability Distributions:** Discrete distributions **-** Uniform, Binomial, Multinomial, Hyper geometric, Poisson, Negative Binomial, Poission; Continuous distributions - Normal, Exponential, Gamma, Weibull and Beta distributions and their properties -Function of Random variables.	6
III	**Sampling Distributions:** Random sampling, Sampling Distributions of Means, Estimation, Properties of point estimators, Confidence interval, Maximum likelihood and Bayes estimators, Prediction intervals.	6
IV	**Testing of Hypothesis:** Sampling distributions – testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions, tests for independence of attributes and Goodness of fit. **Linear Correlation and Regression Analysis:** Introduction, Linear Regression model, Regression coefficient, Lines of correlation, Rank correlation	6

Text Books:

1. Gupta, S.C, and Kapur, J.N., *"Fundamentals of Mathematical Statistics*", Sultan Chand, Ninth Edition, New Delhi,1996.
2. Johnson. R. A., *"Miller & Freund's Probability and Statistics for Engineers",* Sixth Edition, Pearson Education, Delhi, 2000.
3. Douglas C. Montgomery and George C. Runger, "*Applied Statistics and Probability for Engineers",* 5th Edition, 2011.

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Reference books:

1. Walpole, R. E., Myers, R. H. Myers R. S. L. and Ye. K, *"Probability and Statistics for Engineers and Scientists",* Seventh Edition, Pearson Education, Delhi, 2002.
2. Lipschutz. S and Schiller. J, *"Schaum's outlines - Introduction to Probability and Statistics"*, McGraw-Hill, New Delhi, 1998.
3. S. M. Ross, "*Introduction to Probability and Statistics for Engineers and Scientists*" 4th edition.

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HS 305: INDUSTRIAL ECONOMICS AND MANAGEMENT

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	0	0	3	40	60	100	3 hrs

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction to Engineering Economics** - Technical efficiency, economic efficiency - cost concepts: elements of costs, opportunity cost, sunk cost, private and social cost, marginal cost, marginal revenue and profit maximization. **Supply and Demand:** Determinants of demand, law of demand, determinants of supply, law of supply, market equilibrium - elasticity of demand - types of elasticity, factors affecting the price elasticity of demand **National Income Concepts:** GDP and GNP, per capita income, methods of measuring national income. Inflation and deflation:	**8**
II	**Value Analysis** - Time value of money - interest formulae and their applications: single-payment compound amount factor, single-payment present worth factor, equal-payment series compound amount factor, equal-payment series sinking fund factor, equal-payment series present worth factor, equal-payment series capital recovery factor, effective interest rate. **Investment Analysis:** Payback period—average annual rate of return, net present value; Internal rate of return criteria, price changes, risk and uncertainty.	**8**
III	**Principles of Management:** Evolution of management theory and functions of management organizational structure - principle and types - decision making - strategic, tactical & operational decisions, decision making under certainty, risk & uncertainty and multistage decisions & decision tree. **Human Resource Management:** Basic concepts of job analysis, job evaluation, merit rating, wages, incentives, recruitment, training and industrial relations.	**8**
IV	**Financial Management**: Time value of money and comparison of alternative methods; costing – elements& components of cost, allocation of overheads, preparation of cost sheet, break even analysis - basics of accounting - principles	**8**

| of accounting, basic concepts of journal, ledger, trade, profit & loss account and balance sheet. **Marketing Management:** Basic concepts of marketing environment, marketing mix, advertising and sales promotion. **Project Management:** Phases, organization, planning, estimating, planning using PERT & CPM. | |

Text Books:
1. PanneerSelvam, R, **“*Engineering Economics*”**, Prentice Hall of India Ltd, New Delhi.
2. Dwivedi, D.N**., “*Managerial Economics, 7/E”*,** Vikas Publishing House.

Reference Books:

1. Sullivan, W.G, Wicks, M.W., and Koelling. C.P., **“*Engg. Economy 15/E*”**,Prentice Hall, New York, 2011.
2. Chan S. Park, **“*Contemporary Engineering Economics*”**, Prentice Hall of India, 2002.
3. F. Mazda, ***Engg.Management***, Addison Wesley, Longman Ltd., 1998.
4. O. P. Khanna**, *Industrial Engg.and Management*,**DhanpatRai and Sons, Delhi, 2003.
5. P. Kotler, ***Marketing Management, Analysis, Planning, Implementation and Control***,Prentice Hall, New Jersey, 2001.
6. VenkataRatnam C.S &Srivastva B.K, ***Personnel Management and Human Resources***, Tata McGraw Hill.
7. Prasanna Chandra, ***Financial Management****: Theory and Practice*, Tata McGraw Hill.
8. Bhattacharya A.K., ***Principles and Practice of Cost Accounting***, Wheeler Publishing.
9. Weist and Levy, ***A Management guide to PERT and CPM***, Prantice Hall of India.
10. Koontz H.,O’Donnel C.,&Weihrich H, ***Essentials of Management***, McGraw Hill.

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AU-301: ELEMENTS OF AUTOMOBILE ENGINEERING

Teaching Scheme			Credits	Marks			Duration End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	1	0	4	40	60	100	3 hrs

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction to Automobiles:** Classification, Components, Requirements of Automobile Body: Vehicle Frame. Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles. **Clutches:** Introduction to clutches, requirement of Clutches – Principle of Friction Clutch –Wet Type & Dry Types: Single Plate Clutch, Multi plate Clutch, Centrifugal Clutches, Clutch linkages.	**8**
II	**Power Transmission:** Object of the Gear Box; Different types of Gear Boxes; Sliding Mesh, onstant Mesh, Synchromesh Gear Boxes; Drive Lines, Universal Joint, Propeller Shaft, Slip Joint; Front heel drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of load oming on Rear Axles, Full Floating, Three Quarter Floating and Semi Floating Rear Axles. **Suspension Systems:** Need of Suspension Systems, Types of Suspension; factors influencing ride comfort, leaf springs, shock absorber. **Steering System:** Front Wheel geometry & Wheel alignment viz. Caster, Camber, King Pin Inclination, Toe-in/Toe-out; Conditions for true rolling motions of Wheels during steering: Different type of Steering Gear Boxes; Steering linkages and layout; Rack & Pinion Power Steering Gear.	**9**
III	**Automotive Brakes, Tyres & Wheels:** Classification of Brakes; Principle andconstruction details of Drum Brakes, Disc Brakes; Mechanical, Hydraulic, Pneumatic Brakes; Power Assisted Brakes; Tyres of Wheels; Types of tyre & their constructional details, Tyre rotation; Excessive Tyre wear & their causes. **Automotive Electricals:** Purpose & Operation of lead acid Battery, capacity rating. Purpose and Operations of the Starting System; and charging system.	**8**

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Text Books:

1. Automobile Engineering (Vol. 1 & Vol. 2) by Dr. Kirpal Singh, Standard Publishers Distributors.
2. Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.

Reference Books:

1. Automotive Mechanics – Crouse & Anglin, Tata McGraw Hill.
2. Automotive Technology – H.M.Sethi, Tata McGraw Hill.
3. Automotive Mechanics – S.Srinivasan, Tata McGraw Hill.
4. Automotive Mechanics – Joseph Heitner, EWP.
5. Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers. Inc.
6. The Motor Vehicle – Newton steeds Garrett, Butterw

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ME-301: STRENGTH OF MATERIALS-I

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	T	P/D	C	Sessional	End Semesteter	Total	
3	1	0	4	40	60	10	3Hrs

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Simple Stresses and Strains:** Stress & Strain, Types of stresses and strains, elastic limit, Hooke's law, Stress-Strain diagram for ductile and brittle, Factor of Safety, Poisson's ratio, Elastic constants, Young's Modulus, Shear Modulus, and Bulk Modulus, Relationship between elastic constants. Introduction to thermal stresses and strains. **Compound stresses & strains**: Concept of surface and volumetric strains, two – dimensional stress system, complementary shear stresses at a point on a plane. Principal stresses & strains and principal planes. Mohr's circle of stresses, Numerical problems.	9
II	**Bending Stresses in Beams:** Bending stresses in Beams with derivation of Bending equation and its application to beams of circular, rectangular, I & T sections, Composite Beams. **Torsion of Circular Shaft:** Theory of Pure Torsion, Derivation of Torsion equation for a circular shaft subjected to torsion, assumptions, derivation of maximum torque transmitted by a solid shaft, and hollow shaft.	8
III	**Shear and combined stresses in beams**: Shear stresses in beams with derivation of shear stress in rectangular I, T, circular and hollow circular sections. Combined bending, torsion & axial loading of beams. Numerical problems. **Slope & Deflection**: Relationship between bending moment, slope & deflection, Method of integration, Macaulay's method, Mohr's theorem-moment area method, ,. Calculations for slope &deflection of (1) cantilevers and (2) simply supported beams with or without overhang, under concentrated loads, uniformly distributed loads, uniformly distributed loads, or combination of any two or all of these types of loads. distributed loads. Numerical problems.	9
IV	**Theories of Elastic Failure**: Various theories of elastic failure with derivations and graphical representations, applications to problems of two-dimensional stress	8

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	systems with (i) Combined direct loading and bending and (ii) combined torsional and direct loading. Numerical problems.	
	Strain Energy & Impact Loading: Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact. Strain energy of beams in bending, beam deflections. Strain energy of shafts in twisting. Energy methods in determining spring deflection, Castigliano's & Maxwell's theorems, Numerical problems	

Textbooks :

1. *Mechanics of Materials*-Vol.-1, & Vol. 2, E.J. Hearn, Elsevier Publications.
2. *Strengths of Materials* – R.K. Rajput, S.Chand& Sons.
3. *Strength of Materials*- R.K. Bansal, Laxmi Publications.

Reference Books:
1. *Mechanics of Materials*-R.C.Hibbeler, Pearson India.
2. *Mechanics of Solids*-James Goodno, Thomson Publishers.
3. *Strength of Materials*-Popov , PHI, New Delhi.
4. *Strength of Materials*-G.H. Ryder- Third Edition in S.I. units 1969 Macmillan India.

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Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	T	P/D	C	Sessional	End Semester	Total	
3	0	0	3	40	60	100	3Hrs

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction and Basic Concepts:** Application areas of thermodynamics, Systems and Control volumes, Properties of system, Continuum, State and equilibrium, Processes and cycles, Temperature and Zeroth law of thermodynamics, Heat and thermodynamic, concept of work. **First Law of Thermodynamics:** Statement, Heat and work calculations, Application of first law to non-flow and flow systems, steady flow energy equation as applied to boiler, condenser, throttle, nozzle and turbine	8
II	**Second Law of Thermodynamics:** Statements and their equivalence, thermal energy reservoirs, concept of heat engine, refrigerator, heat pump and perpetual motion machines, Carnot cycle and principles. **Entropy:** Concept of entropy, Temperature- entropy plot, Clausius inequality theorem, Principle of Increase of entropy, entropy balance, entropy generation in daily life, first and second law combined, entropy changes of an ideal gas during reversible processes, Available and unavailable energy, Irreversibility, second law efficiency	8
III	**Property Relations:** Introduction to Maxwell relations, Clausius-Clapeyron equation, volume expansivity and isothermal compressibility, Mayer relation, Joule-Thomson coefficient. **Properties of Steam:** Dryness fraction, enthalpy, internal energy and entropy, steam table, polynomial form of steam equations and Mollier chart, First law applied to steam processes	8
IV	**Power Cycles:** Vapor power Cycles: Carnot vapour cycle, Rankine cycle, Ideal reheat Rankine cycle, Introduction to co-generation. Gas Power Cycles: Air standard assumptions, Otto cycle, Diesel cycle, dual cycle, Stirling cycle, Ericsson cycle, Brayton cycle	8

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	Reactive Systems: Combustion, theoretical and actual combustion processes, enthalpy of formation and enthalpy of combustion, adiabatic flame temperature, first law analysis of reactive system	

Text Books

1. *Thermodynamics* by P K Nag, TMH, 5TH Edition
2. *Fundamentals of Classical Thermodynamics* by Van Wylen G.H. & Sonntag R.E., John Wiley & Sons.

Reference Books:

1. *Thermodynamics: An Engineering Approach*, Yunus A. Cengel and Michael A Boles, 7e, TMH.
2. *Thermodynamics and Heat Engines* by R Yadav, Central Publishing house.
3. Holman, J.P. *Thermodynamics*. McGraw- Hill
4. *Thermal Engineering* by Mahesh Rathod, McGrawHill Publications
5. *Engineering Thermodynamics- A Generalized Approach* by P L Dhar, ELSEVIER
6. *Fundamentals of Thermodynamics* by Moran & Shapiro.
7. Schaum's Outlines: *Thermodynamics for Engineers* by Merle C. Potter

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Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	T	P/D	C	Sessional	End Semester	Total	
2	0	3	3	40	60	100	3Hrs

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction:** Introduction to BIS Specification sp: 46- 1988 Code of engineering drawing – Limits. Fits and Tolerance (dimensional and Geometrical tolerance), Surface finish representation.	7
II	**Gear:** Gear terminology. I.S convention of assembly of spur gears, helical gear, bevel gears, worm and worm wheel.	7
	Fasteners: Drawings of various views of Screw threads, metric and BSW threads, Square thread and multi start threads. Nut bolts, Washers, Setscrew, Locknuts and foundation bolts.	
III	**Orthographic view:** Orthographic view from isometric views of machine parts / components. Dimensioning- Sectioning. Exercises on coupling, crankshaft, pulley, piston and connecting rod, cotter and knuckle joints. Riveted joints and Welded joints.	7
IV	**Assembly drawing:** Assembly drawings with sectioning and bill of materials from given detail drawings of assemblies: Lathe tail stock, machine vice, pedestal bearing, Steam stop valve, drill jigs and milling fixture.	7

Text Books:
1. *Machine Drawing*: N D Bhat and V M Panchal, Pub: Charotar Publishing House.
2. *A text book of machine drawing*: PS Gill, Pub: S.K.Kataria& Sons.

Reference Books:
1. *A text books of machine Drawing*: Laxminarayana and Mathur, Pub: M/S Jain Brother. New Delhi.
2. *Machine Drawing*: N Sidheshwar, P Kannaieh, V S Sastry, Pub: Tata McGraw Hill.

HS 306: SOCIOLOGY AND ELEMENTS OF INDIAN HISTORY FOR ENGINEERS

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	T	P/D	C	Sessional	End Semester Exam	Total	
2	0	0	2	40	60	100	3 hrs

COURSE OBJECTIVE:
- To familiarize the students with elements of Indian history and sociological concepts and theories by which they could understand contemporary issues andproblems in Indian society.
- The enable the students to analyse critically the social processes of globalization, modernization and social change.
- To help the students imbibe such skills that will enable them to be better citizens and human beings.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction to sociological concepts** - structure, system, organization, social institution, Culture social stratification (caste, class, gender, power). **Understanding social structure and social processes -** Perspectives of Marx and Weber.	6
II	**Political economy of Indian society** - Industrial, Urban, Agrarian and Tribal society. **Social change in contemporary India** - Modernization and globalization, Secularism and communalism.	6
III	**Introduction to Elements of Indian History -** What is history? ; History Sources - Archaeology, Numismatics, Epigraphy and Archival research. **Indian history and periodization -** evolution of urbanization process: first, second and third phase of urbanization.	6
IV	**From feudalism to colonialism -**the coming of British; Modernity and struggle for independence. **Issues and concerns in post-colonial India (upto 1991) -** Issues and concerns in post-colonial India 2ndphase (LPG decade post 1991)	6

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Text Books:
1. Desai, A.R. (2005), *Social Background of Indian Nationalism*, Popular Prakashan.
2. Giddens, A (2009), *Sociology, Polity*, 6thEdition.
3. Chandoke, Neera & Praveen Priyadarshi(2009), *contemporary India: Economy, Society and Politics*, Pearson.

Reference Books:
1. Guha, Ramachandra(2007), *India After Gandhi*, Pan Macmillan.
2. Haralambos M, RM Heald, M Holborn (2000), *Sociology, Collins*.
3. Sharma R. S..(1965), *Indian feudalism*, Macmillan.
4. Gadgil, Madhab&RamchandraGuha(1999) - *This Fissured Land: An Ecological Histry of India,* OU Press.

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Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	0	0	2	40	60	100	3 hrs

COURSE OBJECTIVES:

- To read and write short, simple texts.
- To understand a dialogue between two native speakers and also take part in short, simple conversations using the skills acquired.
- To offers opportunities for students of engineering for higher studies, research and employment in Germany.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**WichtigeSprachhandlungen:** Phonetics – Sichbegrüßen - Sich und anderevorstellenformell / informell - Zahlen von 1 bis 1 Milliarde - verstehen&sprechen. **Grammatik:** regelmäßigeVerbenimPräsens - "sein" und habenimPräsens - PersonalpronomenimNominativ	6
II	**WichtigeSprachhandlungen:** Telefon Nummernverstehen und sprechen Uhrzeitenverstehen und sagenVerneinung "nicht und kein" (formell und informell). **Grammatik**: Wortstellung – Aussagesatz – W-Frage und Satzfrage (Ja/NeinFrage) Nomenbuchstabieren und notierenbestimmter und unbestimmter Artikelund Negativartikelim Nom. &Akkusativ	6
III	**WichtigeSprachhandlungen:** Tageszeitenverstehen und über Terminesprechen-Verabredungenverstehen – Aufgabenim Haushaltverstehen. **Grammatik:** PersonalpronomenimAkkusativ und Dativ - W-Fragen "wie, wer, wohin,wo, was usw.-Genitivbei Personennamen - ModalverbenimPräsens "können, müssen,möchten"	6
IV	**WichtigeSprachhandlungen:** Sichaustauschen, was man kann, muss – BezeichnungenLebensmittel – Mengenangabenverstehen – PreiseverstehenundEinkaufzettelschreiben	6

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	Grammatik: Wortstellung in SätzenmitModalverben – Konnektor "und" – "noch"-kein-------mehr – "wieviel, wieviele, wie alt, wielange" – PossessivartikelimNominativ		
V	**WichtigeSprachhandlungen:** Freizeitanzeigenverstehen – HobbysundSportarten Anzeigenfür Freizeitpartnerschreibenbzw. daraufantworten –Vorlieben und Abneigungenausdrucken **Grammatik:**Verbenmit Vokalwechselim Präsens – ModalverbenimPräsens"dürfen, wollen und mögen - "haben und sein" imPräteritum – regelmäßigeVerbenimPerfekt – Konnektoren "denn, oder, aber.		**6**

Text Book

1. Studio d A1. Deutsch alsFremdsprache with CD.(Kursbuch und Sprachtraining).

References

1. German for Dummies
2. Schulz Griesbach

HS 308: FRENCH LANGUAGE - I

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	0	0	2	40	60	100	3 hrs

COURSE OBJECTIVES:

- To read and write short, simple texts.
- To understand a dialogue between two native speakers and also take part in short, simple conversations using the skills acquired.
- To offers opportunities for students of engineering for higher studies, research and employment in French.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Grammar and Vocabulary:** Usage of the French verb "se presenter", a verbof self- introduction and how to greet a person- "saluer". **Listening and Speaking:** The authentic sounds of the letters of the Frenchalphabet and the accents that play a vital role in the pronunciation of thewords. **Writing:** Correct spellings of French scientific and technical vocabulary. **Reading:** Reading of the text and comprehension – answering questions.	**6**
II	**Grammar and Vocabulary:** Definite articles, "prepositions de lieu" subjectpronouns. **Listening and Speaking:** Pronunciation of words like Isabelle, presentezandla liaison – vousetes, vousappelez and role play of introducing each other –group activity. **Writing:** Particulars in filling an enrolment / registration form. **Reading Comprehension:** reading a text of a famous scientist and answeringquestions.	**6**
III	**Grammar and Vocabulary:**Verb of possession "avoir' and 1st group verbs"er", possessive adjectives and pronouns of insistence- moi, lui..andnumbers from 0 to 20. **Listening and Speaking:** Nasal sounds of the words like feminine, ceinture,parfum and how to ask simple questions on one's name, age, nationality,address mail id and telephone number. **Writing:** Conjugations of first group verbs and paragraph writing on self – introduction and introducing a third person.	**6**

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	Reading Comprehension: reading a text that speaks of one's profile andanswering questions	
IV	**Grammar and Vocabulary:** Negative sentences, numbers from 20 to 69, verb"aimer"and seasons of the year and leisure activities. **Listening and Speaking:** To express one's likes and dislikes and to talk ofone's pastime activities (sports activities), je fais du ping-pong and nasalsounds of words – janvier, champagne. **Writing-**Conjugations of the irregular verbs: faire and savoir and their usage.Paragraph writing on one's leisure activity- (passé temps favori). **Reading:** a text on seasons and leisure activities – answering questions.	6
V	**Grammar and Vocabulary:** les verbes de direction- to ask one's way and togive directions, verbes- pouvoir and vouloir and 2nd group verbs, a droite, lapremiere a gauche and vocabulary relating to accommodation. **Listening and Speaking:**To read and understand the metro map and henceto give one directions – dialogue between two people. **Writing:**Paragraph writing describing the accommodation using the differentprepositions like en face de, derriere- to locate. **Reading Comprehension:**A text / a dialogue between two on location anddirections- ouest la poste/ la pharmacie, la bibliotheque?.....	6

Text Book

1. Tech French

References

1. French for Dummies.
2. French made easy-Goyal publishers
3. Panorama

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ME-305: STRENGTH OF MATERIALS LAB.

Teaching Scheme			Credits	Marks			Duration End Semester Examination
L	T	P/D	C	I.A.	ESE	Total	
0	0	2	1	30	20	50	3 hrs

Experiments as per the topics in the syllabus for the course 'Analog Electronics Lab' will be conducted in the laboratory class. Following is the list of experiments out of which 8-9 experiments must be performed during the semester:

LIST OF EXPERIMENTS:

1. To study the Brinell and Rockwell hardness testing machine & compare hardness of atleast two types of materials/alloys,

2. To study the Vickers hardness testing machine & perform Vickers hardness test& compare hardness of atleast two types of materials/alloys,

3. To study the Impact Testing Machine and perform the Impact tests (Izod&Charpy),

4. To study the Universal testing machine and perform the tensile test for comparing graphs of atleast two types of materials/alloys,

5. To perform compression test on UTM,

6. To perform bending/shear test on UTM,

7. To perform the torsion test on mild steel/aluminium alloy,

8. To perform fatigue test on mild steel/aluminium alloy,

9. To find Young's Modulus of a beam (rectangular/triangular/circular section) using deflection of beam apparatus,

10. To find Modulus of Rigidity of a specimen using Searl's Apparatus

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AU-302: ELEMENTS OF AUTOMOBILE ENGINEERING LAB

Teaching Scheme			Credits	Marks			Duration End
L	T	P/D	C	I.A.	ESE	Total	Semester Examination
0	0	2	1	30	20	50	3 hrs

Experiments as per the topics in the syllabus for the course 'Analog Electronics Lab' will be conducted in the laboratory class. Following is the list of experiments out of which 8-9 experiments must be performed during the semester:

LIST OF PRACTICALS/EXPERIMENTS:

1. To study and prepare report on the constructional details, working principle and operation of the following
(a) Single plate clutch. (b) Multi plate clutch.

2. To study and prepare report on the constructional details, working principles and operation of the following
(a) Constant mesh Gear Box. (b) Synchromesh Gear Box.

3. To study and prepare report on the constructional details, working principles and operation of the following
(a) Rear Wheel Drive Line. (b) Front Wheel Drive Line. (c) Differentials

4. To study and prepare report on the constructional details, working principles and operation of the following
(a) Starting System. (b) Ignition System.

5. To study and prepare report on the constructional details, working principles and operation of the Charging System.

6. To study and prepare report on the constructional details, working principles and operation of the following
(a) Front Suspension System. (b) Rear Suspension System.

7. To study and prepare report on the constructional details, working principles and operation of Rack and Pinion Power steering system.

8. Adjusting of brake shoes and bleeding the hydraulic brake system.

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ME-307: COMPUTER AIDED DESIGN (CAD) LAB-I

Teaching Scheme			Credits	Marks			Duration End
L	T	P/D	C	I.A.	ESE	Total	Semester Examination
0	0	3	2	30	20	50	3 hrs

Experiments as per the topics in the syllabus for the course 'Analog Electronics Lab' will be conducted in the laboratory class. Following is the list of experiments out of which 8-9 experiments must be performed during the semester:

LIST OF EXPERIMENTS:

1. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing naming layers, setting line types for different layers using various type of lines in Engineering drawing, saving the file with dwg. extension.

2. Layout drawing of a building using different layer and line colors indicating all Building details name the details using text commands, Make a title Block.

3. To Draw Orthographic projection drawings (Front, Top and side) of boiler safety valve giving name the components of the valve.

4. Make an Isometric dimensioned drawing of a connecting Rod using Isometric grid and snap.

5. Draw quarter sectional isometric view of a cotter joint.

6. Draw different types of bolts and nuts with internal and external threading in Acme and square threading standards. Save the bolts and nuts as blocks suitable for insertion.

7. Draw a 3D model of a machine component using 3D primitives and using commands like Union. Subtraction, Revolve, Slice, Rotate 3D etc. Calculate surface Area, Mass, Centre of Gravity and Mass moment of inertia using inquiry commands render the figure made and attach a material to the figure.

8. Draw 3D model of protected type flange coupling.

9. Draw a spiral by extruding a circle.

10. Draw an assembly of Jigs & Fixture in 3D.

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SEMESTER IV

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MA-401: OPTIMIZATION AND CALCULUS OF VARIATIONS

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	T	P/D	C	Sessional	End Semester Exam	Total	
2	2	0	3	40	60	100	3 hrs

COURSE OBJECTIVES:

The objective of this course is to present different methods of solving optimization problems in the three areas of linear programming, nonlinear programming, and classical calculus of variations. In addition to theoretical treatments, there will be some introduction to numerical methods for optimization problems.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction:** A survey of some simplified examples of common real world situations leading to optimization problems, basic formulation and theory of optimization problems. **Linear programming:** Linear programming (optimization of linear functions subject to linear constraints): basic theory; simplex method; duality, practical techniques.	6
II	**Linear programming:** Basic LPP - solution techniques (Simplex, Artificial Basis), Complimentary Slackness Theorem,Fundamental theorem of Duality,degenerate solutions, cycling; Applications - elements of dynamic programming includingHamiltonian, Bellman'soptimality principle. **Transportation and Assignment Problems:** Solution of a balanced transportation problem, degeneracy in transportation problems and alternate solutions, Mathematical problems in formulation of assignment problems.	7
III	**Nonlinear programming:** Nonlinear programming (optimization of nonlinear functionssubject to constraints) with Lagrange multipliers, Karush-Kuhn-Tucker optimality conditions,convexity, duality.	6

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	Approximation methods for nonlinear programming: Line search methods, gradientmethods, conjugate gradient methods; Networkingtechniques – PERT and CPM.	
IV	**Calculus of Variations:**Basic definitions -functionals, extremum, variations, function spaces; Necessary conditions for an extremum, Euler-Lagrange Equation, convexity and it's role in minimization, minimization under constraints; Existence and nonexistence of minimizers;Applications - Isoperimetric problems, Geodesics on the surface.	**6**

Text Books:

1. C. B. Gupta, *"Optimization Techniques in Operation Research,"* I. K. InternationalPublishing House Pvt. Ltd.
2. A. S. Gupta, *Calculus of Variations and Applications*, PHI Prantice hall India.
3. Mukesh Kumar Singh, *"Calculus Of Variations"*, Krishna Prakashan Media (P) Ltd.
4. J. K. Sharma, *Operations Research – Problems and Solutions*, Macmillian Pub.

Reference books:
1. I. M.Gelf and S. V. Fomin, *"Calculus of Variations"* Dover Publications IncMineola,New York.
2. Purna Chand Biswal, *"Optimization in Engineering*, Scitech Publications India Pvt. Ltd.
3. B. S. GREWAL, *Higher Engineering Mathematics*, Krishna Publications.
4. G. Hadly, *Linear Programming*, Narosa Publishing House.
5. KantiSwarup, P. K. Gupta and Manmohan, *"Operations Research,"* Sultan Chand & Sons.

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HS 409: HUMAN VALUES AND PROFESSIONAL ETHICS

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	2	0	3	40	60	100	3 hrs

COURSE OBJECTIVES:

- To enable students to explore the purpose of value education.
- To understand the purpose of harmony with oneself, family, society and nature.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction –Need and Basic Guidelines** 1. Understanding the need , basic guidelines, content and process of value Education 2. Self-Exploration – purpose, content and process, 'Natural Acceptance' and Experiential Validation – as the mechanism for self-explanation.	6
II	**Process for Value Education** 1. Continuous Happiness and Prosperity – A look at basic Human Aspirations. 2. Right Understanding, Relationship and Physical Facilities – basic requirements for fulfillment of aspirations of every human being with their correct priority 3. Understanding Happiness and prosperity – A critical appraisal of the current scenario. 4. Method to fulfill the human aspirations; understanding and living in harmony at various levels	7
III	**Harmony in Human Beings** 1. Understanding human being as a co-existence of the self and the body. 2. Understanding the needs of Self ('I') and 'Body' – Sukh and Suvidha. 3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)	7

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IV	**Harmony in Myself and body**	6
	1. Understanding the characteristics and activities of 'I' and harmony in 'I' 2. Understanding the harmony of I with the Body: Sanyam and Swasthya: correct appraisal of Physical needs, meaning of Prosperity in detail.	
V	**Harmony in Family, Society and Nature**	6
	1. Understanding harmony in the family, society and nature. 2. Understanding values in human relationship; meaning of Nyaya and Program for its fulfillment to ensure Ubhay-tripti. 3. Trust (Vishwas) and Respect (Samman) as the foundational values of relationship.	

Text Books

1. R R Gaur, RSangal and GP Bagaria, *A Foundation Course in value Education*, Published by Excel Books (2009).
2. R R Gaur, R Sangal and G P Bagaria, *Teacher's Manual (English),* 2009.

Reference Books

1. E.F. Schumacher, *Small is Beautiful; a study of economics as if people mattered*, Blond & Briggs, Bratain, 1973.
2. PL Dhar, RR Gaur, *Science and Humanism*, common wealth publishers, 1990.
3. A.N. Tripathy, *Human values,* New Age International Publishers, 2003.
4. E.G. Seebauer& Robert, L BERRY, *Foundational of Ethics for Scientists &Engineers*, Oxford University Press, 2000.
5. M. Govindrajran, S.Natrajan& V.S. Senthi Kumar, *Engineering Ethics (including human Values),* Eastern Economy Edition, Prentice hall of India Ltd.
6. B.L. Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal book Co; Lucknow, 2004, Reprinted 2008.

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AU-401: AUTO FUEL AND LUBRICANTS

Teaching Scheme			Credits	Marks			Duration End
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	**Semester Examination**
3	0	0	3	40	60	100	3 hrs

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Manufacture Of Fuels And Lubricants:** Structure of petroleum refining process, classification of petroleum fuels, thermal cracking, catalytic cracking, polymerization, alkylation isomerisation, blending, products of refining process. Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricants.	7
II	**Properties & testing of fuels:** Thermo-chemistry of fuels, properties and testing of fuels & Lubricants, relative density, calorific value, fire point, distillation, vapor pressure, flash point, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index. API gravity, aniline point Viscosity index etc. Fuel rating & additives Cetane rating, fuel requirements. Additive - mechanism, requirements of an additive, petrol fuel additives and dieselfuel additives - specifications of fuels. COMBUSTION SI Engine - name propagation and mechanism of combustion, normal combustion, knocking, octane, rating. Fuel requirements. CI engine, mechanism of combustion, diesel knock.	8
III	**Alternate Fuels:** Use of alternate fuel in engines- LPG. CNG need for alternate fuels, availability & their properties, general use of alcohols. LPG. CNG. LNG, hydrogen, ammonia, vegetable oils, bio-diesel & biogas. merits & demerits of alternate fuels. Introduction to alternate energy sources like, electric vehicle, hybrid, fuel cell & solar cars. **Lubricants:** Classification of lubricating oils, properties of lubricating oils, tests on lubricants. Greaseclassification, properties, test. Specific requirements for automotive lubricants, oxidation,deterioration and degradation oflubricants, additives, synthetic lubricants.	8
IV	**Theory Of Lubricants:** Engine friction - introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elasto	7

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	hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system, introduction to design of a lubricating system.	

Text Books

1. Internal Combustion Engineering by Ganesan V. TaU McGraw -Hill Publishing Co .. New, Delhi.
2. Lubrication. Raymond G. Gunther, Chipton Book Co., 1971.

Reference

1. Fuels - Solids. Liquids. Gaseous by Brame. J.S.S. and King. I .G.
2. Fuels and Fuel Technology by Francis, W, Vol. I & II
3. Modern Petroleum Technology by Hobson, G.D. & Pohl. W
4. Lubrication-A practical guide to lubricant selection by A.R. Lansdown

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AU-402: FLUID MECHANICS AND FLUID MACHINES

Teaching Scheme			Credits	Marks			Duration End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	1	0	4	40	60	100	3 hrs

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction:** Fluid and flow-definition and types, properties of ideal and real fluids, continuum concept, Lagrangian & Eulerian approach. **Fluid Statics:** General differential equation, manometry, Force on plane and curved surfaces, stability of floating and submerged bodies, Relative equilibrium.	8
II	**Kinematics of fluid:** Steady flow, uniform flow, stream, streak and path lines, continuity equation, stream function, irrotational flow, velocity potential, flow nets, circulation, simple flows, flow around circular cylinder with and without rotation, lift and drag. **Dynamics of fluids:** Concept of system and control volume, Reynold's transportation theorem, Euler's equation, Bernoulli's equation, Navier Stoke's equation and their application to nozzle, venturimeter, orifices and mouth pieces, time taken in emptying a vessel. Pitot - Prandtl tube.	9
III	**Laminar flow of viscous fluids:** Boundary layer concept, boundary layer thickness, displacement, momentum and energy thickness, integral method, drag on flat plate, flow around an airfoil, boundary layer separation**.** **Flow in pipes:** Laminar flow through pipe, total and hydraulic gradient lines, series and parallel connection of pipes, transmission of power through pipes.. Turbulent flow: Fluid friction and Reynolds number.	8
IV	**Centrifugal Pumps:** Classification, velocity vector diagrams and work done, hydraulic and manometric efficiency, vane shape, head capacity relationship and pump losses, pressure rise in impeller, minimum starting speed, multi-stage pumps, Similarity relations and specific speed, net positive suction head, cavitation and maximum suctions lift, performance characteristics. **Reciprocating Pumps:** Construction and operational details, discharge coefficient, volumetric efficiency and slip, work and power input, effect of acceleration and friction on indicator diagram (pressure – stroke length plot) air vessels and their utility. Centrifugal vs. reciprocating pumps.	9

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Text Books:
1. Modi and Seth, Fluid Mechanics and Hydraulic Machines, CBS Publishers.
2. Munson, Young, Okiishi and Huebsch, Fundamentals of Fluid Mechanics, Wiley India (6th Edition).
3. R.K. Bansal, A Text Book of Fluid Mechanics and Hydraulic Machines, Laxmi Publications (P) Ltd., New Delhi

Reference Books:
1. White F.M., Fluid Mechanics, Tata McGraw Hill.
2. Douglas, Gasiorek, Swaffield and Jack, Fluid Mechanics, Pearsons (5th Edition).
3. Som, S.K. and Biswas, G., Introduction to Fluid Mechanics and Fluid Machines, Tata Mc-Graw Hill.
4. Bansal, R.K., Text Book of Fluid Mechanics and Hydraulic Machines, Laxmi Publications (P) Ltd.
5. Agarwal, Fluid Mechanics and Machinery, Tata McGra

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ME-402: STRENGTH OF MATERIALS-II

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**1**	**0**	**4**	**40**	**60**	**100**	**3Hrs**

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Thin Walled Vessels**: Derivation of Hoop & Longitudinal stresses & strains in cylindrical & spherical vessels under internal pressure. Change in volume of vessel under pressure, Numerical problems. **Thick Cylinders & Spheres**: Derivation of equations for radial & hoop stresses and strains in thickcylinders and spherical shells. Compound cylinders and spherical shells subjected to internal fluidpressure only, hub shrunk on solid shaft. Wire-wound cylinders. Numerical problems.	9
II	**Rotating Rims, Discs & Cylinders**: Stresses and strains in (i) rotating rims, neglecting the effect ofspokes, (ii) rotating discs, including disc of uniform strength and disc shrunk on hub (iii) rotatingcylinders (solid & hollow). Numerical problems.	8
III	**Columns & Struts**: Columns under axial load, concept of instability and buckling, slenderness ratio. Derivation of Euler's formulae for the elastic buckling load. Euler's, Rankine Gordon's formulae ,Johnson's empirical formula for axial loading of columns and their applications, eccentric compression of a short strut of rectangular & circular sections, Numerical problems. **Springs**: Stresses in closed and open coiled helical springs subjected to axial loads and twisting couples. Leaf springs, flat spiral springs. Numerical Problems.	9
IV	**Bending of Curved Bars**: Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature. Stresses in crane hooks, rings and chain links of circular & trapezoidal sections. Numerical Problems. **Unsymmetrical bending:** Introduction to unsymmetrical bending, Shear Center, Numerical problems.	8

Textbooks :

1. Mechanics of Materials-Vol.-1, & Vol. 2, E.J. Hearn, Elsevier Publications.
2. Strengths of Materials – R.K. Rajput, S.Chand& Sons.
3. Strength of Materials- R.K. Bansal, Laxmi Publications.

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Reference Books:

1. Mechanics of Materials-R.C.Hibbeler, Pearson India (9th Edition).
2. Mechanics of Solids-James Goodno, Thomson Publishers.
3. Strength of Materials-Popov , PHI, New Delhi.
4. Strength of Materials-G.H. Ryder- Third Edition in S.I. units 1969 Macmillan India.

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ME-403:   I.C. ENGINES

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction** Heat engines; Internal and external combustion engines; Classification of I.C. Engines; Cycle of operations in four strokes and two-stroke IC engines and their comparative study; Fuels**:** SI and CI engine fuels, Rating of fuels, Scavenging and scavenging blowers, Air standard cycles and Fuel air cycles, Variable specific heat and its effects, Dissociation and other losses, Actual cycles, Deviation of actual engine cycle from ideal cycle, TDC, BDC, Torque, Power. **Compression Ignition Engines** Combustion phenomenon in C I engines, Stages of combustion, Delay period, Knocking, Pressure-Crank angle diagram, Factors affecting combustion and knocking, Types of combustion chambers. **Spark Ignition Engines**Combustion**:** Combustion phenomenon in SI Engines, Ignition delay, Flame propagation, Pressure-Crank angle diagram, Abnormal combustion, Auto ignition, Detonation and Knocking, Factors affecting combustion and detonation, Types of combustion chambers.	**9**
II	**Fuel System – SI Engines: Theory** of carburetion, Simple carburettor, Essential parts of modern carburettor, Types of carburettors, Types of fuel injection systems in SI engines, Continuous injection system, Timed injection system, Electronic Fuel Injection systems (EFIs)/MPFi, Working of Sensors, Functions of ECU in Petrol Engine. Spark Plug and its requirements, Battery, Magneto, Electronic ignition systems. GDI Technology, Turbo in Petrol Engines. **Fuel System – CI Engines:** Fuel Injection Systems**:** Unit Pump, Inline Pump, Rotary Pump, Engine Governors: necessity and characteristics, Types of nozzle, Electronic Diesel Control, CRDi Technology, System Layout, Function of ECU in diesel engine, Working of Sensors, Turbocharger and its types, VGT, Twin-turbo.	**9**
III	**Engine lubrication:** Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems, Engine Cooling**:** Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling,	**8**

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	Supercharging/Turbo-charging**:** Objectives, Effects on power output and engine efficiency **Engine Testing and Performance:** Measurement of Break Horse Power, Indicated Power, Fuel Consumption, Air flow, BMEP, Performance characteristic of SI and CI Engines, Effect of load and Speed on mechanical, indicated thermal, break thermal and volumetric efficiencies, Heat balance sheet		
IV	**After-treatment technologies: -**Working of Catalytic Converter & its types, SCR, DPF, DOC, POC, LNT.**Exhaust Emissions:**Homologation, Emission Standards, Applicable Standards in India, Future Norms, and Significance of Fuel in meeting emissions. Classification of Segments, Emission Test Cycles, COP, Emission Measurement Techniques, On board Diagnosis, OBDI, OBDII. **Alternate Fuels:** Alcohol - Hydrogen - Natural Gas and Liquefied Petroleum Gas – Biodiesel- Biogas Properties - Suitability - Engine Modifications - Merits and Demerits as fuels.		8

Text Books

1. Ganesan V., (1999), Internal Combustion Engines, Tata McGraw Hill.
2. John B. Heywood, (2000), Internal Combustion Engine Fundamentals, McGraw Hill.

Reference Books

1. Rowland S.Benson and N.D.Whitehouse, (2000) Internal combustion Engines, Vol. I and II, Pergamon Press.
2. Colin R.Feriguson, and Allan.T.Kirkpatrik, (2000), I.C.engines Applied Thermosciences
3. Richard.L.Bechfold, Alternative Fuels Guide Book, SAEInternational Warrendale,1997.
4. ''Alcohols as motor fuels progress in technology'' - Series No.19 - SAE Publication USE - 1980.
5. Heisler Heinz, Advanced Engine Technology, Hodder & Stoughton Ltd

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Teaching Scheme			Credits	Marks				Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**		
2	0	0	2	40	60	100		3 hrs

COURSE OBJECTIVE:

- To familiarize students (Prospective engineers) with elementary knowledge of laws that would be of utility in their profession.
- To familiarize students with the constitution of India and laws in new areas viz. IPR, ADR, Human Rights, Right to Information, Corporate law, Law relating Elections and Gender Studies.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Constitutional Law:** Nature of Indian Constitution (features), fundamental rights, duties and directive Principles of State Policy (DPSP's), forms of Governments, structure of Government of India, role and responsibility of executive, legislature/parliament and judiciary, nature of Indian federal system, center state and relations. Basic structure of the Indian constitution, basic features of the Indian, constitutional amendments - GolakNath, KeshwanandaBharti, Maneka Gandhi (1978) and S.R. Bommai case (1994), (floor test).	6
II	**Law of contract:** General principles of Indian Contract Act, 1862, kinds of Government contracts and dispute settlement, standard and printed form of contract, essential elements of valid contract proposal, acceptance communication and revocation thereof, relevance of time in contractual obligation. Main objectives of Arbitrates and Conciliation Act-1996, tort and law of tort, general principles of tort law, classifications of torts: property vs. person.	6
III	**Administrative Law:** Evolution, nature and its scope, conceptual objection against growth of administrative rule of law and separation of power, clarification of administrative actions, judicial review of administrative actions, exclusion of judicial review and concept of "Ombudsman";Right to Information Act, 2005 (Sub Section 1 - 20) **Environmental Law:**Definition, meaning and its nature, environmental (Protection) Act-1986, Water (Preservation and Control of Pollution) Act-1974, Air (Prevention and Control of Pollution) Act-1981; Environmental pollution, overall remedies and procedures.	8
IV	**Human Rights:** Legality of human rights, universal declaration of human rights,	6

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	1948, difference between civil and political rights, individual and human rights - human rights of child, weaker section of society, prisoners, and refugees, International Human Rights Commission.	

Text Books:
1. D.D. Basu, *Shorter Constitution of India*, Prentice Hall of India, (1996)
2. MeenaRao, *Fundamental concepts in Law of Contract*, 3rd Edn. Professional Offset, (2006)
3. H.O.Agarwal, *International Law and Human Rights*, Central Law Publications, (2008)

Reference Books:
1. H.M. Seervai, *Constitutional Law of India*, Tripathi Publications, (1993).
2. S.K. Kapur, *Human Rights under International Law and Indian Law,* Central Law Agency, (2001)
3. NeelimaChandiramani, *The Law of Contract: An Outline*, 2nd Edn. Avinash Publications Mum, (2000)
4. Avtarsingh, *Law of Contract*, Eastern Book Co., (2002).
5. Anson W.R.(1979), *Law of Contract*, Oxford University Press

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<p align="center">**HS-411: GERMAN LANGUAGE – II**</p>

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	0	0	2	40	60	100	3 hrs
Prerequisite							
HS 302: GERMAN LANGUAGE - I							

COURSE OBJECTIVES:

- To enable the students to speak and understand about most of the activitiesin the day to day life.
- The students will be able to narrate their experiences in Past Tense.
- The students will be able to understand and communicate even with German Nationals.
- By the end of Phase – II the students will have a reasonable level of conversational skills.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Wichtige Sprachhandlungen:** Zimmersuche, Möbel **Grammatik**: Verbenmittrennbaren Vorsilbenim Präsens und Perfekt. Verbenmittrennbaren Vorsilben und Modalverbenim Präsens. Verbenmituntrennbaren Vorsilbenim Perfekt.Unregelmäßige undgemischteVerbenimPerfekt.	6
II	**Wichtige Sprachhandlungen**: Kleidung ,Farben, Materialien. **Grammatik:** formelle Imperativsätzemit "Sie" informelle Imperativsätze Vorschlägemit "wir" – "sollen/wollenwir" - Sollich? Modalpartikeln "doch""mal" "doch mal.	6
III	**Wichtige Sprachhandlungen:** Sehenswürdigkeite (Prater, BrandenburgerTör, Kolossium, Eifeltürm). **Grammatik:** Ortsangabenmit Akk. Und Dativ "alle","man" Indefinitepronomen"etwas", "nichts".	6
IV	**Wichtige Sprachhandlungen:** Essen und TrinkenimRestaurant, Partyvorbereitung und Feier.	6

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| | Grammatik: NomenausAdjektivennach "etwas"und "nichts" NomenausdemInfinitiv von Verben, zusammegesetzteNomen und ihreArtikel. Adjektiveim Nom.undAkk.nachunbestimmten Artikel, Negativartikel und Possessivartikel | |

Text Books

1. Studio d A1. Deutsch alsFremdsprache with CD.(KursbuchundSprachtraining).

References

1. German for Dummies
2. Schulz Griesbach

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Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	0	0	2	40	60	100	3 hrs
Prerequisite							
HS 303: FRENCH LANGUAGE - I							

COURSE OBJECTIVES:

- To enable the students communicate effectively with any French speaker
- To enable students to access information on the internet, send e mails, pass level 1 exam conducted by Alliance Française de Madras.
- To enable students to enhance their lexical and technical competence and have a competitive edge in the international market.By the end of Phase – II the students will have a reasonable level of conversational skills.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Grammar and Vocabulary:** The second group verbs: Finir, rougir, grossir,grandir. "Les preposition de temps": à, en, le, de 7h à 8h, jusqu' à, vers. Listening and Speaking – the semi- vowels: Voilà, pollutant. Writing - thedays of the week,months, technical subjects, time, "les spécialitésscientifiques et l' annéeuniversitaire, paragraph writing about time table. Reading: Reading of the text and comprehension – answering questions.	**6**
II	Grammar and Vocabulary – The adjectives, the nationality, feminine &masculinenoun forms "les métiersscientifiques". Listening and Speaking – Vowels: soirée, année, près de, très. Writing: Countries name, nationality, "les métiersscientifiques", numbers from:69 to infitive and some measures of unit.Reading Comprehension: reading a text.	**6**
III	Grammar and Vocabulary – near future, The demonstrative adjectives, Expressthe aim by using the verb, Listening and Speaking –"La liaison interdite – enhaut". Writing – some scientific terms, French expressions to accept an invitation.Sentence framing. Reading Comprehension – reading a text.	**6**
IV	Grammar and Vocabulary –the verbs: manger, boire, the partitive articles Listening and Speaking – "le 'e' caduc Writing- the food, the ingredients, fruits,vegetables, expression of quantity, paragraph writing about food habits. Reading –reading a text.	**6**

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Text Books

1. Tech French

References

1. French for Dummies.
2. French made easy: Goyal publishers.
3. Panorama.

ME-405:   I.C. ENGINE LAB

Teaching Scheme			Credits	Marks			Duration End Semester Examination
L	T	P/D	C	I.A.	ESE	Total	
0	0	2	1	30	20	50	3 hrs

Experiments as per the topics in the syllabus for the course 'Analog Electronics Lab' will be conducted in the laboratory class. Following is the list of experiments out of which 8-9 experiments must be performed during the semester:

List of Experiments:

1. To study the construction details of 2 Stroke and 4 Stroke Engines.
2. To study the valve timing diagram of engine. (4 stroke petrol/diesel engine)
3. To perform Morse Test on engine(4 stroke petrol/diesel engine)
4. To perform Speed Test on engine (4 stroke petrol/diesel engine)
5. To perform Load Test(Rope Brake/Eddy Current/hydraulic dynamometer) on engine (4 stroke petrol/diesel engine)
6. To perform Heat Balance test on engine (4 stroke petrol/diesel engine)
7. To perform experimental determination of Air fuel ratio and volumetric efficiency of the engine (4 stroke petrol/diesel engine)
8. To study the effects of Supercharging/turbo charging on Performance Characteristics of an engine (4 stroke petrol/diesel engine)
10. To study the difference between Carburettors based fuel system & EFI.
11. To study the difference between Inline Pump, Rotary Pump &CRDi System for a four cylinder diesel engine.
12. To study the effect of Injection Timing & Pressure on Single Cylinder Diesel Engine using Open ECU & perform Exhaust Gas/Smoke analysis of engine.
12 To study the effect of Spark Timing & Lambda on Single Cylinder Petrol Engine using Open ECU & perform Exhaust Gas/Smoke analysis of engine.
13 To study the construction details of Ignition system (Battery, Magneto, Electronic).

Teaching Scheme			Credits	Marks			Duration End Semester Examination
L	T	P/D	C	I.A.	ESE	Total	
0	0	2	1	30	20	50	3 hrs

Experiments as per the topics in the syllabus for the course 'Analog Electronics Lab' will be conducted in the laboratory class. Following is the list of experiments out of which 8-9 experiments must be performed during the semester:

LIST OF PRACTICALS/EXPERIMENTS:

1. Temperature dependence of viscosity of lubrication oil by Redwood Viscometer.

2. Viscosity Index of lubricating oil by Saybott Viscometer.

3. Flash and Fire points of Diesel, K-Oil, Bio Diesel.

4. Flash and Fire points of lubricants.

5. Drop point of grease and mechanical penetration in grease
.
6. Calorific value of liquid fuel.

7. Calorific value of gaseous fuel

8. Study of semi solid lubrication in various Automobile Unit & Joints

9. Study of lubrication in transmission, final drive, steering gearbox.

10. Study of analytical equipment for oil analysis.

11. To find out volatility characteristic of different fuels by ASTM distillation methods (diesel, gasoline lubricants).

Teaching Scheme			Credits	Marks			Duration End Semester Examination
L	T	P/D	C	I.A.	ESE	Total	
0	0	3	2	30	20	50	3 hrs

Experiments as per the topics in the syllabus for the course 'Signals & Systems lab.' will be conducted in the laboratory class. Following is the list of experiments out of which 8-9 experiments must be performed during the semester:

LIST OF EXPERIMENTS:

1. To determine the coefficient of impact for vanes.

2. To determine the coefficient of discharge of Notch (V and Rectangular types)

3. To determine the friction factor for the pipes.

4. To determine the coefficient of discharge of venturimeter.

5. To determine the coefficient of discharge, contraction & velocity of an orifice.

6. To find critical Reynolds number for a pipe flow.

7. To determine the meta-centric height of a floating body.

8. To determine the minor losses due to sudden enlargement, sudden contraction and bends.

9. To study the constructional details of a Centrifugal Pump and draw its characteristic curves.

10. To study the constructional details of a Reciprocating Pump and draw its characteristic curves.

11. To study the constructional details of a Hydraulic Ram and determine its various efficiencies.

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AU-501: AUTOMOTIVE ELECTRICALS & ELECTRONICS

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE OBJECTIVE:

Knowledge in vehicle electrical and electronics components for engine operation. Enhancing the knowledge of revsor and microprocessor applications in vehicle control systems. Gaining information's on modern safety system in vehicle braking.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Storage Battery**: Principles of lead acid cells and their characteristics, construction and working of lead acid battery. types of batteries, testing of batteries, effect of temperature on capacity and voltage, battery capacity, voltage, efficiency, charging of batteries, sulphation and desulphation, maintenance and servicing. Fault diagnosis. New developments in electrical storage.	**9**
II	**Ignition System**: Conventional ignition system and study of its components. Types of ignition systems, spark advance and retarding mechanisms. Types of spark plugs, ignition timing, maintenance, servicing and fault diagnosis. Electronic ignition systems, programmed ignition, distributor less ignition. **Starter motor**: Construction and working of series and shunt automotive starter motor,types of device arrangement, solenoid switches, starter motor troubles and repairs. **Electronic controls of carburetion**, component of fuel injection systems, multipoint injection. Bosch Lvariation electronic control diesel fuel injection	**10**
III	**Charging system**: Principle of generation of direct current. Principle,	

	construction and working of alternator generating systems. Maintenance, servicing and trouble shooting. Bosch com- pact alternator. **Electrical Systems**: Earth return and insulated return systems, six volt and twelve volt systems, fusing of circuits, low and high voltage automotive cables, wiring diagram for typical automotive wiring systems, maintenance and servicing.	**9**
IV	**Dash board units and electrical accessories:** Principle of automobile illumination, head lamp construction and wiring, horn, wind screen wiper signaling devices, fog lamps, auxiliary lighting, temperature gauge, oil pressure gauge, fuel gauge, speedometer, odometer. Number system codes and data representation: Binary numbers, number base conversion, decimal, octal and hexadecimal numbers, BCD codes, memory representation of positive and negative integers, conversion real numbers, floating point notations and representations of floating point numbers, binary arithmetic's, addition and subtraction of binary numbers, ones and two's complement method. Logic gates, arithmetic circuits and introduction to microprocessors: Study of basic and universal logic gates, study of X-OR and X-NOR gates, flip flop, S-R, S-J flip flop and counters and shift resistance, half adders and subtracters.	**11**

Text Books:

1. "*Automotive Electrical auxiliary systems",* By N R. Khatawale Digital
2*.* "*Logic and Computer Design by Mano",* Prentice hall of India

References:

1*.* "*Automotive Electrical systems",* By Young and Griffith, Butterworth
2. "*Basic automotive electrical systems",* By C.P. Nakra, Dhanpat Rai.
3. "*Automotive mechanics ",*By William H. Grouse, TMH 5. Modem Electrical Equipments
-
   By A. W. Judge,
4. "*Automotive Electrical Equipment ",*By P.I. Kohli, TMH

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AU-502:   COMPUTER AIDED DESIGN (CAD)

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	T	P/D	C	Sessional	End Semester	Total	
2	2	0	3	40	60	100	3Hrs

COURSE OBJECTIVE:

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction**: Design steps, role of computers in design and drafting, computer hardware, types of display - raster display, vector display, color display, input devices, output devices. **Performance Curves**: 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	9
II	**Two Dimensional Transformation**: Mathematical aspects of translation, scaling, shearing, rotation, Reflection, Composite (concatenation) transformation, concatenation properties of matrices, practical example - rotation about a pivot point, scaling relative to fixed point, scaling relative to arbitrary directions, shearing relative to a fixed point. Inverse Transformation: Inverse translation, scaling, rotation shearing matrix. **Three-Dimensional Transformations:** Scaling, translation, rotation.	9
III	**Three-Dimensional Viewing Operations:** Projections- Multiview orthographic projections, axonometric projections, Oblique projections, Perspective projections, Vanishing points, Special techniques for producing perspective views. **Solid Modelling System:** Octree or Quadtree representations, boundary or perimeter modelling, primitive or constructive solid geometry or building block method.	8
IV	**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

Text Books:

1. *Mathematical Elements for Computer Graphics*   : D.F. Rogers & J. Alan Adam.
2. *Microcomputer Graphics using Pascal*   : Richard Halpern
3. *Computer Graphics*   : Hern & Baker
4. *Introduction to CAD/CAM*   : Oniver & Zimer
5. *Computer graphics and Geometrical Modeling for Engineers* : Vera

ME-501: KINEMATICS OF MACHINES

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	2	0	3	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction:** Mechanism and machines, kinematics links, kinematic pairs, kinematic chains, plane and space mechanism, kinematic inversion, equivalent linkages, four link planar mechanisms, straight line mechanisms, steering mechanisms, pantograph. **Kinematic Analysis of Plane Mechanisms:** Displacement analysis, general plane motion, instantaneous center of velocity, graphical and analytical methods of velocity and acceleration analysis.	**6**
II	**Cams:** Classification of cams and followers, disc cam nomenclature, construction of displacement, velocity and acceleration diagrams for different types of follower motions, analysis of follower motions, determination of basic dimension, synthesis of cam profile by graphical approach, cams with specified contours, tangent and circular arc cams.	**6**
III	**Belt, Rope and Chain drives**: Introduction to belts, ropes, law of belting, design of belt drives, flat & v-belt drives, conditions for transmission of max. Power **Gears:** Introduction, terminology, various types of gears and applications, fundamental law of gearing, Gear profile, involute, cycloidal, interference and undercutting. Spur gear: *Path of contact, arc of contact, minimum teeth to avoid interference, i*ntroduction to *helical, spiral bevel and worm gears*. Synthesis of simple, compound and reverted gear trains, analysis of epicyclic gear trains.	**6**
IV	**Kinematic synthesis of Mechanisms:** Type, number and dimensional synthesis, function generation, path generation and body guidance two and three position synthesis of four bar and slider crank by graphical and analytical methods, Freudenstein's equation precision position, structural error, Chebychev spacing, transmission angle.	**6**

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Text Books:

1. V.P. Singh, "*Theory of Machines*", Dhanpat Rai Publications, New Delhi, 2016**.**
2. Amitabha Ghosh, Ashok Kumar Mallik, *Theory of Mechanisms and Machines,* Third Edition Affiliated East West Press.
3. S.S. Rattan, "*Theory of Machines",* McGraw Hill, (4th edition), 2014

Reference Books:

1. J.S.Rao, R.K. Dukkipati, **"*Mechanism and Machine Theory",*** Second Edition, New age International.
2. Gordon R. Pennock, Joseph E. Shigley, John J. Uicker , **"*Theory of Machines and Mechanisms",*** Oxford University Press, 2014.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	1	0	4	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Steady State Heat Conduction:** Introduction, 1-dimensional heat conduction through a plane wall, long hollow cylinder, hollow sphere, conduction equation in cartesian, polar and spherical co-ordinate systems. steady state conduction with heat generation: introduction, 1 – dimensional heat conduction with heat sources, extended surfaces (fins), fin effectiveness 2-dimensional heat conduction.	8
II	**Transient Heat Conduction:** systems with negligible internal resistance, biot number, transient heat conduction in plane wall, cylinders, spheres with convective boundary conditions, hiesler chart solution, relaxation method. **Convection:** Forced convection – Thermal and hydro-dynamic boundary layers, equation of continuity, momentum and energy equations, flow over a flat plate and flow through tube, fluid friction and heat transfer (colburn analogy), free convection from a vertical flat plate, empirical relations for free convection from vertical and horizontal of planes and cylinders.	9
II	**Thermal Radiation:** Introduction, Stefan-Boltzmann law, Wien Displacement Law, Kirchoff's Law, concept of black body and grey body, black body radiation, shape factors and their relationships, heat exchange between non-black bodies, equivalent electrical network for radiative exchange in an enclosure of two or three gray bodies, radiation shields.	9
IV	**Heat Exchangers:** Introduction, classification, fouling factor, overall heat transfer coefficient, analysis of a parallel/counter flow heat exchanger, heat exchanger effectiveness, LMTD, NTU effectiveness method.	8

Text Books:

1. F.P. Incropera, & D.P. Dewitt, "*Fundamentals of Heat and Mass Transfer*", Wiley 2013
2. Yunus A. Cengel,Afsin J. Ghajar, "*Heat and Mass Transfer: Fundamental and Applications*," McGraw Hill Education.

Reference Books:

1. J.P. Holman, "*Heat Transfer*," McGraw-Hill Higher Education
2. D.S. Kumar, "*Heat and Mass Transfer*," Kataria& Sons, Delhi.
3. S.K. Som, "*Introduction to Heat Transfer*," Prentice Hall India Learning Private Limited, 2008.

ME-504: MACHINE DESIGN-I

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	1	0	4	40	60	100	3 hrs.

Note:

(1) ***Design Data Book Compiled by PSG College of Engineering & Technology, Coimbatore***, is permitted to be used during the Examination.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction:** To machine design, design process and design creativity, types of design, design synthesis, principles of design in aesthetics and ergonomics, standards in design, concurrent engineering, mechanical properties of the commonly used engg. materials, basic criteria of selection of materials, factor of safety under different loading conditions, concept of tearing, shearing, crushing, bending etc. **Principles of design:** B.I.S. system of designation of steel, B.I.S System of designation of C.I. B.I.S system of fits &tolerances, standardization and inter-changeability, design considerations of casting, forging and machining, different types of fluctuating / variable stresses, study of stress concentration, concept of fatigue and endurance strength, fatigue design for finite and infinite life against combined variable stress using Goodman and Soderberg's criterion, design for static loading, design for manufacture and assembly (DFMA).	**9**
II	**Shafts and Keys :** Design of shafts subjected to twisting moment, bending moment and combined bending and twisting, shafts subjected to fluctuating loads, design of shafts on basis of rigidity, design of hollow shafts, flexible shafts, critical speed of shafts, design of different types of keys, splines.	**8**
III	**Riveted joints:** Methods of riveting, rivet materials, caulking and fullering, design of rivets for boiler joints, eccentrically loaded riveted joints, **Welded joints:** weld, design for various loading conditions in torsion, shear or direct load, eccentrically loaded welded joints.	**8**
IV	**Cotter and knuckle joints:** comparison between keys and cotters, design of socket and spigot cotter joint, gib and its use, gib and cotter joint, design procedure for knuckle joint.	**9**

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| | **Pipe joints:** Introduction, stresses in pipes, designing of pipes, hydraulic pipe joint for high pressures, steam pipes, steam pipe fittings, oil piping. | |

Text Books:

1. V.B.Bhandari, **"Design of Machine Element"s,** McGraw Hill Education (India) Pvt. Ltd., 4th edition.
2. R.S.Khurmi, J.K. Gupta, "**Machine Design",** S. Chand & Sons, 2014.

Reference Books:

1. P.C. Sharma and D.K. Aggarwal, "**Machine design**", S K Kataria& Sons.
2. Joseph EShigley, Charles Mischke, Richard Budynas, Keith Nisbett, "**Mechanical Engg. Design** (Metric Editions)", McGraw Hill Book Co.
3. Steven R. Schmid, Bernard J. Hamrock, Bo Jacobson, "**Fundamentals of Machine Elements"**, McGraw Hill Higher Education.

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Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	0	0	3	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Materials:** Resources and their implications, materials and their applications in engineering. **Solid Solutions and Phase diagram:** Introduction and types of solid solutions, importance and types of phase diagram, systems, phase and structural constituents, cooling curves, Gibb's phase rule, lever rule, definition of eutectic, eutectoid, peritectic and peritectoid systems, iron carbon equilibrium diagram and TTT diagram.	**7**
II	**Heat Treatment:** Purpose and classification of heat treatment processes, annealing normalizing, stress relieving, hardening, tempering, carburizing, nitriding, cyaniding, flame and induction hardening. properties of micro-constituents like austenite, ferrite, pearlite, martensite. **Deformation of Metals:** Elastic and plastic deformation, mechanism of plastic deformation, twining, conventional and true stress strain curves for polycrystalline materials, yield point phenomena, strain hardening, age hardening work hardening, Bauschinger effect, recovery, recrystallization and grain growth.	**9**
III	**Mechanical Behavior of Materials:** Types of polymers, ceramics, composites, and glasses, mechanical behavior of polymers, ceramics, composites, and glasses, mechanical testing of materials. **Alloys and alloying elements:** Effect of various alloying elements on the mechanical properties. properties of important alloys used in mechanical engineering practice.	**9**
IV	**Failures of metals**: Failure analysis, fracture- process & its types and their characteristics, brittle fracture theories, cleavage fracture, methods to improve fracture strength, fatigue and characteristics of fatigue. **Creep & Corrosion:** Definition and concept, creep curve, mechanism of	**9**

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| | creep, impact of time and temperature on creep, creep fracture, creep testing and prevention against creep. corrosion: introduction, types of corrosion, mechanism and effect of corrosion, prevention of corrosion. | |

Text Books:

1. Lawrence H. Van Vlack, "*Elements of Material Science and Engineering",* Pearson Education India.

2. V. Raghavan, "*Material Science & Engineering: A First Course",* Prentice Hall of India Pvt. Ltd, New Delhi, 6th edition

Reference Books:

1. W.D. Callister Jr, "*Material Science and Engineering-An Introduction"*, Wiley India Pvt Ltd., 6th edition.
2. O.P. Khanna, "*A Text Book of Material Science & Metallurgy"*, Dhanpat Rai publications.
3. Kenneth G. Budinski, Michael K. Budinski, "*Engineering Materials (Properties and Selection)"*, Pearson, 6th edition.

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AU-511: COMPUTER AIDED DESIGN (CAD) LAB-II

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
0	0	3	2	30	20	50	3 hrs.

Suggested List of Experiments:

1. To introduce the concept of calibration, scale in images, importing and exporting different CAD/CAM file types from one software to another software.
2. Manual part programming using G and M codes for Turning, Step turning, Taper turning, multiple turning, Facing, Multiple facing, thread cutting and radius turning on cylindrical components.
3. CNC Milling program involving linear motion and circular interpolation.
4. CNC Milling program involving contour motion and canned cycles.
5. CNC Milling program involving Pocket milling
6. Diagnosis and trouble shooting in CNC machine
7. CNC code generation using any CAM software.
8. Simulation of machining operations using any CAM software.
9. Route sheet generation using CAM software.
10. Study and practical demonstration of Modern Manufacturing Methods like Wire-Cut EDM, ECM, USM, AJT, LBM, etc.
11. Study and practical demonstration on Coordinate measuring machine,
12. Study and practical demonstration on Vertical Machining centre and Horizontal Machining centre
13. Study on Rapid Prototyping Technologies,

Note: At the end of laboratory work, student shall submit evidence of team work in the form of project /assignments with neat documentation as assigned by concerned lab incharge/faculty.

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AU-512: AUTOMOTIVE ELECTRICALS AND ELECTRONICS LAB

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	T	P/D	C	IA.	ESE.	Total	
0	0	2	1	30	20	50	3Hrs

Practicals as per the topics in the syllabus for the course will be conducted in the laboratory class.

Following is the suggested list of exercises out of which a minimum of 8-10 experiments must be performed by a student during the semester:

LIST OF EXPERIMENTS:

1. Study of different type of Battery construction and different battery test.
2. Study of different automotive electrical system (Starting system, Ignition system, Lighting system, wiring harness.)
3. Assembling and dismantling of Starter motor used in automobile.
4. Assembling and dismantling of alternator used in automobile.
5. Trouble shooting with Ignition system.
6. Study of different color code system used in automotive wiring system.
7. Study of different Electrical Equipments & Accessories (Speedometer, Warning lights, Electric Horn , Wind shield wipers system)
8. Study of different sensor used in modern automotive system.
9. Study of various electronics system (Electronic fuel injection system, Electronic Ignition system, Air bag, ABS , Electronic fuel injector cleaner.

ME-513: HEAT TRANSFER LAB.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	T	P/D	C	Sessional	End Semester Exam	Total	
0	0	2	1	30	20	50	3 hrs.

Suggested List of Experiments

1. To determine the thermal conductivity of a metallic rod.
2. To determine the thermal conductivity of an insulating powder.
3. To determine the thermal conductivity of a solid by the guarded hot plate method.
4. To find the effectiveness of a pin fin in a rectangular duct natural convective condition and plot temperature distribution along its length.
5. To find the effectiveness of a pin fin in a rectangular duct under forced convective conditions and plot temperature distribution along its length.
6. To determine the surface heat transfer coefficient for a heated vertical tube under natural convection and plot the variation of local heat transfer coefficient along the length of the tube. Also compare the results with those of the correlations.
7. To determine the average heat transfer coefficient for an externally heated horizontal pipe under forced convection and plot Reynolds and Nusselt numbers along the length of pipe. Also compare the results with those of the correlations.
8. To measure the emissivity of the grey body (plate) at different temperature and plot the variation of emissivity with surface temperature.
9. To find overall heat transfer coefficient and effectiveness of a heat exchange under parallel and counter flow conditions. Also plot the temperature distribution in both the cases along the length of heat of heat exchanger.
10. To verify the Stefen-Boltzmann constant for thermal radiation.

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ME-508: ROBOTICS

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	0	0	2	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Robotic manipulation:** Automation and robots classification – drive technologies work-envelope geometries, motion control method, application: robot specifications – no. of axes, capacity and speed, reach and stroke, tool orientation, repeatability, precision, accuracy, operating environment.	6
II	**Direct kinematics**: The arm equation homogenous co-ordinates – frames, translation and rotations, composite homogenous transformations, screw transformations, link co-ordinates, the arm equation, a five-axis articulated robot, a four-axis SCARA robot, a six-axis articulated robot. **Inverse kinematics:** Solving the arm equation: the inverse kinematics problem general properties of solutions, tool configuration, inverse kinematics of a five-axis articulated robot, four-axis SCARA robot, six-axis articulated robot and three-axis planer articulated robot.	6
III	**Work space analysis and trajectory planning:** work space analysis, work envelope of a five axis articulated robot, work envelope of a four axis SCARA robot, work space fixtures, The pick and place Operation, Continuous path motion, Interpolated motion, straight line motion. **Differential motion and statics:** the tool configuration Jacobian matrix, joint space singularities, generalised inverses, resolved motion rate control, n>6, rate control of redundant robots: n>6: rate control using (1)–inverse, the manipulator jacobian.	6
IV	**Manipulator dynamics**: Lagrange equation, kinetic & potential energy, generalized force, Lagrange-Euler dynamic model, dynamic model of a two axis planer articulated robot and a three axis SCARA robot, direct & inverse dynamic recursive Newton – Euler formulation, dynamic model of a one axis robot.	6

	Robot control: The control problem, state equations, constant solutions, linear feedback system, single axis PID control, PD gravity control, computer – torque control, variable structure control, impedance control.	

Text Books:

1. Robert J. Schilling, "*Fundamental of Robotics (Analysis & Control)*", Pearson.
2. John J.Craig, "*Introduction to Robotics (Mechanics & Control)*", Pearsons Education India, 3rd edition.

Reference Books:

1. Wolfram Stadler, "*Analytical Robotics & Mechatronics*", McGraw Hill Education (ISE Editions).
2. Mikell P Grover, Mitchell Weiss, Roger Nagel, "*Industrial Robotics – Technology Programming & Applications*", McGraw Hill Education(ISE Editions)
3. Tsuneo Yashikawa, "*Foundations of Robotics: Analysis and Control*", PHI learning Pvt Ltd.
4. R.K. Mittal, I J Nagrath, "*Robotics and control*", McGraw Hill Education (India) Pvt. Ltd., India, 2003.

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Open Elective-III

ME-509: AUTOMOBILE TECHNOLOGY

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	0	0	2	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction to Automobiles:** Classification, components, requirements of automobile body: vehicle frame. types, front engine rear drive & front engine front drive vehicles, four wheel drive vehicles. **Clutches:** Introduction to clutches, requirement of clutches – principle of friction clutch – wet type & dry types: single plate clutch, multi plate clutch, centrifugal clutches, clutch linkages.	6
II	**Power Transmission:** Object of the gear box, different types of gear boxes, sliding mesh, constant mesh, synchromesh gear boxes, drive lines, universal joint, propeller shaft, slip joint, front wheel drive, principle, function, construction & operation of differential, rear axles, types of load coming on rear axles, full floating, three quarter floating and semi floating rear axles.	6
III	**Suspension Systems:** Need of suspension systems, types of suspension, factors influencing ride comfort, leaf springs, shock absorber. **Steering System:** Front wheel geometry & wheel alignment viz. caster, camber, king pin inclination, toe-in/toe-out, conditions for true rolling motions of wheels during steering: different type of steering gear boxes, steering linkages and layout, rack & pinion power steering gear.	6
IV	**Automotive Brakes, Tyres & Wheels:** Classification of brakes, principle and construction details of drum brakes, disc brakes, mechanical, hydraulic, pneumatic brakes, power assisted brakes, tyres of wheels, types of tyre & their constructional details, tyre rotation, excessive tyre wear & their causes. **Automotive Electricals:** Purpose & operation of lead acid battery, capacity rating. purpose and operations of the starting system, and charging system.	6

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Text Books:
1. Dr.Kirpal Singh, "*Automobile Engineering (Vol. 1 & Vol. 2)*", Standard Publishers Distributors, Delhi.
2. WilliamH.Crouse, "*Automotive Mechanics*", McGraw-Hill Higher Education
3. S.K. Gupta, "*A Textbook of Automobile Engineering*", S. Chand

Reference Books:
1. S.Srinivasan, "*Automotive Mechanics*", McGraw Hill Education.
2. Joseph Heitner, "*Automotive Mechanics – Principles and Practices*", CBS Publishers.
3. Anthony E. Schwaller, "*Motor Automotive Technology*", S. Chand(G/L) & Company Ltd.
4. K Ramakrishana, "*Automobile Engineering*", PHI Learning Private Limited.

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ME-510: VALUE ENGINEERING

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	0	0	2	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Value Engineering Concepts:** Advantages, applications in product development, process improvement, service improvement and system design, problem recognition, role in productivity, criteria for comparison, elements of choice.	6
II	**Analysis of Functions:** Anatomy of function, values: use, antique, cost, esteem and exchange, primary versus secondary versus tertiary/unnecessary functions, functional analysis: function analysis system technique and quantitative evaluation of ideas, case studies.	6
III	**Value Engineering Techniques:** Selecting products and operations for VE action, timing, VE programmes, determining and evaluating functions, assigning rupee equivalents, developing alternate means to required functions, decision making for optimum alternative, use of decision matrix, make or buy decisions, measuring profits, reporting results and follow up.	6
IV	**Implementation and Management of Value Engineering:** Action plan, record progress, report progress, review meetings, problems in implementation, human factors. Level of VE in the organization, size and skill of VE staff, small plant VE activity management supports, Audit of savings.	6

Text Books:

1. Lawrence D. Miles, "*Techniques of Value Analysis and Engineering"*, Eleanor Miles Walker, 1989
2. Richard Park, "*Value Engineering : A Plan for Invention"*, CRC Press
3. J.V. Michael, and W.P.Wood, "*Design to Cost"*, Wiley Interscience, 2004

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Reference Books:

1. H.G. Tufty, *"Compendium on Value Engineering",* The Indo American Society 1983
   G. Jagannathan, *"Getting More at Less Cost"*, Tata McGraw-Hill Education

AU-601: COMPUTER AIDED MANUFACTURING (CAM)

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	1	0	4	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction:** Historical background, role of computers in manufacturing, automation, Types of automation, Automation strategies, fundamentals of NC, Need of NC machine tool, Elements of NC machine tools, Axes of NC machines, NC machine tools, tooling for NC machines, Steps in NC manufacturing, advantages of NC system, applications of NC systems, economic of NC manufacturing, machining centers. **Computer Numerical Control:** Principle of operation of CNC features of CNC systems, development in CNC systems, adaptive control, direct numerical control (DNC), standard communication interfaces, programmable logic controllers (PLCs), communication networks, configuration of CNC system.	8
II	**CNC Part Programming:** Introduction, Manual part programming: structure and format of part program NC programming codes, programming for two axis control system, programming for three axis control system. Programming for CNC Lathe and CNC Milling. Computer aided CNC part programming: Need of Computer aided part programming, computer aided Part Programming languages: Automatically programmed tools programming (APT) and Compact-II, CAD/CAM-Based part programming.	9
III	**Group Technology And Cellular Manufacturing:** Introduction to industrial robotics, Introduction, Group technology: Part families, parts classification and coding, production flow analysis, machine cell design, Computer aided process planning (CAPP): Types of process planning system, Advantages of CAPP. **Computer Aided Quality Control (CAQC)**: Use of computers in QC, Computer aided inspection (CAI): contact inspection methods, non contact inspection, in process gauging, online inspection and quality	9

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	control, Machine Vision system, Computer aided testing (CAT).	
IV	Introduction, fixed programmable and flexible automation, Types of NC systems, MCU & other components, Co-ordinate system, NC manual part programming, G & M codes, part program for simple parts, Computer assisted part programming Introduction, FMS component, Types of FMS, FMS layout, Planning for FMS, advantage and applications.	**8**

Text Books:

1. *Automation: Production Systems & CAM*   Groover, Eaglewood
2. *An introduction to Automated Process Planning*   Chand & Wysk , T.K.Kundra
3. *System approach to Computer Integrated Design and Manufacturing* Nanua Singh
4. *FMS* R.Maleki
5. *CNC Machines* ,Pabla, BS & Adinathan
6. *CAD/CAM* ,Suresh Dalela & PK Jain

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AU-602: MANUFACTURING PROCESS

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
2	**2**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE OBJECTIVE:

The automobile components such as piston, connecting rod, crankshaft, engine block, front axle, frame, body etc., are manufactured by various types of production processes involving casting, welding, machining, metal forming, power metallurgy etc. Hence Automobile Engineering students must study this course.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Casting:** Casting types, procedure to make sand mould, types of core making, moulding tools, machine moulding, special moulding processes – CO2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects.	9
II	**Welding:** Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing.	10
III	**Machining:** General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan and Turret lathe. Basics of CNC machines. General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, Electron beam machining and Laser beam machining	11
IV	**Forming And Shaping Of Plastics:** Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of – Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and	9

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| | typical applications - Compression moulding – Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods | |

Text Books:

1. Sharma P.C, *"Production Technology : Manufacturing Processes",* 7th Edition", S. Chand   Publisher, 2008.
2. Rao P.N, *"Manufacturing Technology, Vol I and II",* Tata McGraw Hill Publishing Co., 2nd edition, 2009.

References:

1. Hajra Choudhary S. K and Hajra Choudhary A. K, *"Elements of Manufacturing Technology",* Vol II, Media Publishers, Bombay, 2007
2. Jain R. K, *"Production Technology : Manufacturing Processes, Technology and Automation",* 17th Edition, Khanna Publishers, 2011.
 3. Kalpakjian, *"Manufacturing Engineering and Technology",* 4th edition, Addison Wesley Congmen Pvt. Ltd., Singapore, 2009.
4. Chapman W. A. J, *"Workshop Technology Vol. I and II",* Arnold Publisher, New Delhi, 2001.

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ME-602: MEASUREMENT AND CONTROL

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	0	0	3	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**General Concept:** Need and classification of measurements and instruments, basic and auxiliary functional elements of a measurement system, mechanical versus electrical/electronic instruments, primary, secondary and working standards. **Static and Dynamic characteristics of Instruments:** Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution: speed of response, lag, fidelity and dynamic error, dead time and dead zone. zero, first and second order systems and their response to step, ramp and sinusoidal input signals. error in measurement: sources of errors, systematic and random errors: statistical analysis of test data.	**8**
II	**Functional Elements:** Review of Electro-mechanical sensors and transducers – variable resistance, inductance and capacitive pickups, photo cells and piezo-electric transducers, and application of these elements for measurement of position/displacement, speed/velocity/acceleration, force and liquid level etc. **Strain Gauges:** Resistances strain gauges, gauge factor, bonded and unbonded gauges, surface preparation and bonding technique, signal conditioning and bridge circuits, temperature compensation, application of strain gauges for direct, bending and torsional loads.	**9**
III	**Pressure and Flow Measurement**: Bourdon tube, diaphragm and bellows, vacuum measurement – Mecleod gauge, thermal conductivity gauge and ionisation gauge, dead weight gauge tester. Electromagnetic flux meters, ultra-sonic flow meters and hot wire anemometer: Flow visualisation technique. **Temperature Measurement:** Thermal expansion methods – bimetallic thermometers, liquid-in-glass thermometer and filled-in-system thermometers, thermo-electric sensors-common thermo couples,	**8**

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	reference junction considerations, special materials and configurations: metal resistance thermometers and thermistors, optical and radiation pyrometers, calibration, standards.		
IV	**Speed, Force, Torque and Shaft Lower Measurement:** Mechanical tachometers, vibration and tachometer and stroboscope, proving ring, hydraulic a pneumatic load cells, torque on rotating shafts, absorption, transmission and driving dynamometers. **Controls:** Control system-open and closed loop system, elements of a control system, servo mechanism process control and regulators, transfer function, block diagram and overall transfer function of a multi loop control system, signal flow graph and Mason's Rule system stability – Routh and Harwitz criteria stability, Time and frequency domain Nyquist plot for stability study.	**9**	

Text Books:

1. Ernest O. Doebelin, "*Measurement system: Application and Design",* McGraw Hill Higher Education.
2. D.S. Kumar, "*Mechanical Measurement and Control",* Metropolitan Book Co. Pvt. Ltd., New Delhi.
3. Thomas G Beckwith, Roy D Marangoni, John H. Lienhard V , "*Mechanical Measurements"*, Pearson Education India

Reference Books:

1. J.P. Holman, "*Experimental Methods for Engineers"*, McGraw Hill Education.
2. Benjamin C. Kuo, Farid Golnaraghi, "*Automatic Control System"*, Wiley.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	1	0	4	40	60	100	3 hrs.

Note:

(1)   ***Design Data Book compiled by PSG College of Technology, Coimbatore***, India is permitted to be used during the Examination.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Sliding contact Bearings:** Functions, classification, Selection of bearing type, types of lubrication – boundary, mixed and hydrodynamic lubrication, properties of lubricants, oil grooves, hydrostatic bearings, gas bearings, bearing characteristic number, critical pressure and heat generation in journal bearing, design procedure of journal bearing, Reynolds's equation, design of pivot and collar bearing.	8
II	**Rolling contact bearings:** Classification, basic static load rating, basic dynamic load rating, static equivalent load, dynamic equivalent load, load life relationship, reliability, material and manufacture of ball and roller bearings, selection of bearing from manufacturer's catalogue, bearing failure, lubrication of rolling bearings.	9
III	**Gears:** beam and wear strength of gear tooth- Lewis equation, form or Lewis factor for gear tooth, causes of gear tooth failures, dynamic load on gear- Buckingham equation, force analysis and design of spur, helical, bevel & worm gears including the consideration for maximum power transmitting capacity, gear lubrication.	8
IV	**Springs:** Types of springs, design for helical springs against tension, compression and fluctuating loads, design of leaf springs, nipping, surging phenomenon in springs. **Design of IC engines parts and Crane Hook:** Design of cylinder, piston, connecting rod and crankshaft, design of crane hook.	9

Text Books:

1. V.B. Bhandari, "***Design of Machine Elements",*** McGraw Hill Education (India) Pvt. Ltd., 4th edition.
2. R.S. Khurmi, J.K. Gupta, "***Machine Design",*** S. Chand & Sons, 2014.

Reference Books:

1. P.C. Sharma and D.K. Aggarwal, "*Machine design*", S K Kataria& Sons.
2. Joseph E Shigley, Charles Mischke, Richard Budynas, Keith Nisbett, "*Mechanical Engg. Design*," (Metric Editions), McGraw Hill Book Co.
3. Steven R. Schmid, Bernard J. Hamrock, Bo Jacobson, "*Fundamentals of Machine Elements*", McGraw Hill Higher Education.

ME-604: OPERATIONS RESEARCH

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	2	0	3	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Definition and characteristics** of operations research (O.R.), Decision making, Scientific decision making, approach for scientific decision making in O.R., need and limitations of O.R. definition of models, classification of models, construction of models, approximations of O.R. models.	4
II	**Allocation Model:** Analysis of industrial situations to find characteristics like key decision objective, possible alternatives & restrictions – three categories of allocation type situation to be considered general mathematical formulation for linear programming feasible and optimal solutions. **Network Models:** Transportation models, methods of finding starting solution Vogel's approximation method to find feasible solution in transportation models, methods for finding optimal solution. assignment model, Hungarian method to find optimal solution in assignment models.	8
III	**Introduction to Queuing Theory:** Cyclic shortest route models, traveling salesman's problem and branch and bound method to solve it. a cyclic shortest route models and their solution by graphical methods. queuing theory, various types of queuing situations and their solutions. **Theory of games** introduction, Two-person zero-sum games, the maximum –minimax principle, games without saddle points – mixed strategies, 2 x n and m x 2 games – graphical solutions, dominance property, use of L.P. to games, algebraic solutions to rectangular games.	6
IV	**PERT & CPM:** Network situations where PERT & CPM can be applied, planning, scheduling & control, work-breakdown structure. **(a) PERT Networks:** Events and activities, construction of network, forward & backward planning, Fulkerson's rules, optimistic, pessimistic & most likely time estimates, frequency distribution, Mean, variance and standard deviation, expected time and latest occurrence time, definitions	6

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	of slack and critical path.	
	(b) CPM Networks: Similarity and differences of CPM and PERT construction of network, earliest event time, float, total float, free float, independent float, contracting the network so as to find an optimum project schedule.	

Text Books:
1. Hamdy A Taha, "*Operations Research : An Introduction"*, Pearson Education India
2. Prem Kumar Gupta, D.S.Hira, "*Operations Research"*, S.Chand Publications.

Reference Books:
1. KantiSwarup, P.K. Gupta, Man Mohan, "*Operations Research"*, Sultan Chand & Sons
2. K. Rajagopal, "*Operation Research"*, PHI Learning Private Limited.

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Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	0	0	3	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Static and Dynamic Force Analysis:** Static force analysis of planar mechanisms, dynamic force analysis including inertia and frictional forces of planar mechanisms. **Balancing of Rotating Components:** Static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing machines.	**8**
II	**Dynamics of Reciprocating Engines:** Engine types, indicator diagrams, gas forces, equivalent masses, inertia forces, bearing loads in a single cylinder engine, crankshaft torque, engine shaking forces. **Balancing of Reciprocating Parts:** Balancing of single cylinder engine, balancing of multi cylinder, inline, radial and V type engines.	**9**
III	**Governors:** Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors. **Flywheel:** Introduction, coefficient of fluctuation of energy and speed, design of flywheel – solid disk and rimmed flywheels.	**8**
IV	**Dynamometers**: types of dynamometers, prony brake, rope brake and band brake dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer. **Gyroscope:** precession angular motion and gyroscopic couple and their effects on aeroplane, ship during steering, rolling and pitching. Stability of four wheel vehicles moving on curved paths.	**9**

Text Books:

1. Amitabha Ghosh, Ashok Kumar Mallik, "*Theory of Mechanisms and Machines*", 3rd Edition, Affiliated East West Press.

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2. S.S. Rattan, "***Theory of Machines",*** McGraw Hill Education (India)Pvt. Ltd.

Reference Books:

1. Joseph Edward Shigley, John Joseph Uicker Jr., "***Theory of Machines and Mechanisms"***, McGraw Hill Education Pvt. Ltd.
2. J.S.Rao and R.V.Dukkipati, "***Mechanism and Machine Theory"***, New Age International.
3. V.P.Singh, "***Theory of Machines",*** Dhanpat Rai Publications.

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AU-611: COMPUTER AIDED MANUFACTURING (CAM) LAB.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
0	0	2	1	30	20	50	3 hrs.

Suggested List of Experiments:

1. To introduce the concept of calibration, scale in images, importing and exporting different CAD/CAM file types from one software to another software.
2. Manual part programming using G and M codes for Turning, Step turning, Taper turning, multiple turning, Facing, Multiple facing, thread cutting and radius turning on cylindrical components.
3. CNC Milling program involving linear motion and circular interpolation.
4. CNC Milling program involving contour motion and canned cycles.
5. CNC Milling program involving Pocket milling
6. Diagnosis and trouble shooting in CNC machine
7. CNC code generation using any CAM software.
8. Simulation of machining operations using any CAM software.
9. Route sheet generation using CAM software.
10. Study and practical demonstration of Modern Manufacturing Methods like Wire-Cut EDM, ECM, USM, AJT, LBM, etc.
11. Study and practical demonstration on Coordinate measuring machine,
12. Study and practical demonstration on Vertical Machining centre and Horizontal Machining centre
13. Study on Rapid Prototyping Technologies,

Note: At the end of laboratory work, student shall submit evidence of team work in the form of project /assignments with neat documentation as assigned by concerned lab incharge/faculty.

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ME-612: THEORY OF MACHINES LAB.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
0	0	2	1	30	20	50	3 hrs.

Suggested List of Experiments:

1. To study various types of kinematic links, Pairs, Chains and Mechanisms, to study inversions of 4 Bar Mechanisms, Single and Double slider crank mechanisms.
2. To plot slider displacement, velocity and acceleration against crank rotation for Single Slider Crank mechanism.
3. To find Coefficient of friction between Belt and Pulley.
4. To study various type of Cam and Follower arrangements.
5. To plot follower displacement Vs cam rotations for various Cam Follower systems.
6. To generate spur gear involute tooth profile using simulated gear shaping process/ to study various types of gears – Helical, worm & bevel gear.
7. To study various types of gear trains – simple, compound, reverted, epicyclic and differential.
8. To perform experiment on Watt/Porter, Proell, Hartnell Governors to prepare performance characteristic curves and to find stability and sensitivity.
9. To study gyroscopic effects through models and also to determine gyroscopic couple on motorized gryoscope.
10. To perform the experiment for static balancing on static balancing machine.
11. To perform the experiment for dynamic balancing on dynamic balancing machine.
12. Determine the moment of inertial of connecting rod by compound pendulum method

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ME-613: SEMINAR

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
0	0	3	2	50	50	100	3 hrs.

Suggested List of Activities:

Current topics related to any advanced topics assigned by the faculty or any (or more) of the advances in engineering affecting society or topics focussed as per future needs of mankind as also envisaged in following areas but not limited to:

1. Effect of advances in engineering on industry and society,
2. Impact of Financial Regulatory bodies on manufacturing as well as GDP,
3. Modern practices in Telecom Industry, and its effect on human behaviour,
4. Impact of technology on sports, and its effect on human behaviour,
5. Agricultural management and production,
6. Space Technologies and Innovations by mankind,
7. Effect of Technology on Education and Engineering, and its effect on society,
8. Role of Innovations leading to real Product Development within India and Exports from country.
9. Development of indigenous technologies, and Status of Innovation in general.
10. Intellectual Property Rights, Patents, and their effect on Product Development and Prosperity of a Country,
11. Modernization and Monetary Policy and its effects on Economy,
12. Any Current Topic of relevance to India with local as well as global perspective.

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AU-608: AUTOMOTIVE AIR-CONDITIONING

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	T	P/D	C	Sessional	End Semester	Total	
3	0	0	3	40	60	100	3Hrs

COURSE OBJECTIVE:
At the end of the course, the students will be able to understand the components of the automotive air-conditioning and their functions and the latest developments in this field.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Air Conditioning 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
II	**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.	10
III	**Refrigerant:** Containers handling refrigerants, tapping into the refrigerant container, refrigeration system diagnosis, diagnostic procedure, ambient conditions affecting system pressures.	9
IV	**Air Routing and Temperature Control:** Objectives, evaporator airflow through the recirculating unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control and handling systems. **Air Conditioning Service:** Air conditioner maintenance and service, servicing heater system removing and replacing components, trouble shooting of air controlling system, compressor service.	10

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Text Books:

1. William H. Crouse and Donald I. Anglin - *"Automotive Air conditioning"* - McGraw Hill Inc. - 1990.
2. Boyce H.DWiggins - **"Automotive Air Conditioning"** - Delmar – 2002

References:

1. Mitchell information Services, Inc - *"Mitchell Automatic Heating and Air Conditioning Systems"* - Prentice Hall Ind. - 1989.
2. Paul Weiser - *"Automotive Air Conditioning"* - Reston Publishing Co., Inc., - 1990.
3. MacDonald, K.I., - *"Automotive Air Conditioning"* - Theodore Audel series – 1978
4. Goings.L.F. – *"Automotive Air Conditioning"* - American Technical services - 1974.

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE OBJECTIVE:
The purpose of this course is to impart adequate knowledge on SI and CI Engines.
Construction and operation of IC Engine . Fuels and Combustion in IC Engines .
Performance calculation

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Combustion of Fuels**: Combustion equations, Theoretical air, excess air, air fuel ratio, equivalence ratio, exhaust gas composition, Air-fuel ratio from exhaust gas composition, and heating value of fuels.	9
II	**Thermodynamics of Combustion**: Thermo-chemistry, First law analysis of reacting systems, Adiabatic combustion temperature, Second law analysis of reacting systems, criterion for chemical equilibrium, Equilibrium constant for gaseous mixtures, Evaluation of equilibrium composition, chemical availability.	10
III	**Kinetics of Combustion**: Rates of reaction, Reaction order and molecularity complex reactions, chain reactions, Arrhenius rate equation, Collection theory, activated complex theory, Explosive and general oxidative characteristics of fuels. **Flames**: Laminar and Turbulent flames, Premixed and Diffusion flames, Burning velocity and its determination, Factors affecting burning velocity, Quenching, Flammability and Ignition, Flame stabilization in open burners.	11
IV	**Engine Combustion**: Combustion in SI and CI engines, stages of combustion in SI and CI engines, Normal combustion and abnormal combustion, Emissions from premixed combustion, Emission from Non premixed combustion, Control of emissions.	9

Text Books:

1.Stephen R.Turns, "***An Introduction to Combustion***", McGraw Hill Book Company.1996.

Refrences:

1. Irwin Glassman, **"*Combustion, Third Edition*",** Academic Press, 1996.
2. Sharma. S. P and Chandramohan, **"*Fuels and Combustion*",** Tata McGraw Hill Book Co., 1984.

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AU-610: MARKETING AND SALES MANAGEMENT

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	T	P/D	C	Sessional	End Semester	Total	
3	0	0	3	40	60	100	3Hrs

COURSE OBJECTIVE:

This course provides an understanding of the types of data generated and used in the product lifecycle, the current tools and methodologies in the management of that data, and system analysis and implementation techniques for using PDM as the backbone supporting a company's product development and implementation activities. Interaction between various enterprise systems is also discussed**.**

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction:** Market- definition, types. Kinds of goods, marketing role, characteristics. Marketing interface with other functional areas. Marketing management forces. **Consumer Behaviour:** Consumer values, buyer behaviour- influencing factors, models. Consumer and industrial buyers-identifying target customers-market segmentation positioning.	**9**
II	**Product:** – what is product – consumer & industrial products – new product development – design-branding-packaging-labelling-product life cycle-sales forecasting & demand estimation . **Price:** Pricing . **Place:** Nature of distribution channel- channel design decisions- retailing wholesaling. **Promotion:** Advertising and personal selling-direct selling.	**10**
III	**Sales Management:** Marketing management Vs. Sales management- sales management and business enterprise- the role of personal selling-skills for successful sales persons – designing the sales force strategy and structure –recruitment – selection – training-compensation motivation of sales people.	**9**

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IV	**Current Trends in Marketing:** Information technology and its impact in marketing decisions-e-commerce-multilevel marketing-consumer protection: awareness of consumer rights, laws and consumerism.	**11**

Text Books:

1. Kotler p., and Armstrong, **_Principles of Marketing"_,** 11th edition, PHI.

References:

1. Still R.R., Cundiff E.W., and Govoni N.A.P., **_Sales Management"_,** PHI.
2. Sherlekar, S.A., **_Marketing Management"_,** 3rd edition, MacMillan, India

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AU-701: AUTOMOTIVE POLLUTION & CONTROL

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE OBJECTIVE:

The course provides a comprehensive knowledge in environmental science, environmental issues and the management. To acquire knowledge about environmental pollution- sources, effects and control measures of environmental pollution.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction:** Pollutants - sources - formation - effects - transient operational effects on pollution. Introduction, Pollutants, sources, formation of HC and CO in SI engines, NO formation in SI and CI engines, Particulate emission from SI and CI engines, Smoke Emission in CI engines. Effect of operating variables on Emission formation **SI Engine Combustion And Pollutant Formation:** Chemistry of SI engine combustion - HC and CO formation in 4-stoke and 2-stroke SI engines - NO formation in SI engines - Particulate emissions form SI engines - Effects of operating variables on emission formation.	11
II	**CI Engine Combustion And Emissions:** Basics of diesel combustion. Smoke emission in diesel engines, NOx emission from diesel engines. Particulate emission in diesel engines. Color and aldehyde emissions from Diesel engines. Effects of operating variables on emission formation. **Post Combustion Treatment:** Introduction, physical conditions and exhaust gas compositions before treatment, catalytic mechanism. Thermal reactions, installation of catalyst in exhaust lines, NOx treatment in diesel engines. Diesel trap oxidizers	10
III	**Control Techniques Engine Emission Reduction:** Design changes - Optimization of operating factors - Exhaust gas recirculation - Fumigation - Air injection PCV system - Exhaust treatment in SI engines - Thermal reactors – Catalytic converters - Catalysts - Use of unleaded petrol.	10

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	Test Procedure & Instrumentation For Emission Measurement: Test procedures, NDIR analyser, thermal conductivity and flame ionization detectors, Chemiliuminescent analyser, analysers for NOx, Gas chromatograph - Orsat apparatus - Smoke meters, spot sampling and continuous indication types like Bosch, Hart ridge.		
IV	**Laws and Regulations:** Historical background, regulatory test procedures (European cycles), exhaust gas pollutants (European rail road limits), particulate pollutants, European statutory values, inspection of vehicles in circulation (influence of actual traffic conditions and influence of vehicle maintenance) Indian Emission Standards	**8**	

Text Books:

1. Ganesan V, *"Internal combustion engines",* 4th edition, Tata McGraw Hill Education, 2012.

References:

1. Michael F. Hordeski, *"Alternative Fuels: The Future of Hydrogen",* The Fairmont Press, Inc., 2008.
2. Rajput R. K, *"A textbook of Internal Combustion Engines",* 2nd edition, Laxmi Publications (P) Ltd, 2007.
3. *"Society of Automotive Engineers",* Alternative Fuels: Fuel Cells and Natural Gas, Society of Automotive Engineers, Incorporated, 2000.
4. Thipse S. S, *"Alternative Fuels: Concepts, Technologies and Developments",* Jaico Publishing House, 2010.

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ME-701: INDUSTRIAL AUTOMATION AND ROBOTICS

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	0	0	3	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Basic principles of automation,** Hard automation, flexible automation extending the capabilities of conventional machines through improved devices and manipulators, transfer machines for assembly, multispindle automatics. **Introduction to Robotics:** Synthesis of elements with movability constraints, classification and specification of robots, laws of robotics, elements of robot anatomy, hydraulic, pneumatic and electrical manipulators, end-effectors and their design.	8
II	**Robotic manipulation:** automation and robots classification – drive technologies work-envelope geometries, motion control method, application: robot specifications – no. of axes, capacity and speed, reach and stroke, tool orientation, repeatability, precision, accuracy, operating environment.	9
III	**Direct kinematics**: the arm equation homogenous Co-ordinates – frames, translation and rotations, composite homogenous transformations, screw transformations, link Co-ordinates, the arm equation, a five-axis articulated robot, a four-axis SCARA robot, a six-axis articulated robot.	8
IV	**Inverse Kinematics:** Solving the arm equation: the inverse kinematics problem general properties of solutions, tool configuration, inverse kinematics of a five-axis articulated robot, four-axis SCARA robot, six-axis articulated robot and three-axis planer articulated robot. **Performance analysis of industrial robots:** Performance Analysis and their manufacturing applications, Economics of robotics.	9

Text Books:

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1. John J. Craig, "*Introduction to Robotics: Mechanics & Control*", Pearson Eduaction India
2. R.K. Mittal, I J Nagrath, "*Robotics and control*", McGraw Hill Education (India) Pvt. Ltd., India, 2003.
3. S. R Deb, S Deb, "*Robotics Technology and Flexible Automation*", Tata McGraw Hill Education.

Reference Books:

1. Hodges, "*Industrial Robotics*", Jaico Publications (India) Pvt. Ltd.
2. A. Bhattacharya and G. Sen, "*Principles of Machine Tools*", New Central Book Agency, Kolkata.

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ME-702: REFRIGERATION AND AIR CONDITIONING

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	1	0	4	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction:** Definition of refrigeration & air conditioning, Necessity, Methods of refrigeration, Coefficient of performance (COP), fundamentals of air-conditioning system, refrigerants- classification, nomenclature, desirable properties, comparative study, secondary refrigerants, Introduction to eco-friendly refrigerants and cryogenics. **Air Refrigeration Systems:** Carnot refrigeration cycle, Brayton refrigeration or the Bell Coleman air refrigeration cycle, Air craft refrigeration systems, Simple cooling and Simple evaporative types, Boot strap and Boot strap evaporative types, Regenerative type and Reduced Ambient type system, Comparison of different systems.	7
II	**Vapour Compression (VC) Refrigeration Systems:** (a) Simple Vapour Compression (VC) refrigeration systems- limitations of reversed carnot cycle with vapour as the refrigerant, analysis of VC cycle considering degrees of sub cooling and superheating, , comparison of VC cycle with air refrigeration cycle. (b) multistage refrigeration systems- necessity of compound compression, compound VC cycle , intercooling with liquid sub –cooling and / or water inter cooler: multistage compression with flash intercooling and / or water inter-cooling, systems with individual or multiple expansion valves, Individual compression system with individual or multiple expansion valves, individual compression systems with individual or multiple expansion valves with and without intercoolers.	9
III	**Other Refrigeration Systems**: (a) Vapour Absorption Refrigeration (VCR) systems – basic systems, actual COP of the system, performance, relative merits and demerits, properties of aqua ammonia, Electrolux refrigeration. (b) Steam Jet Refrigerating (SJR) System- (c) Cascade refrigerating systems- necessity selection of pairs of refrigerants for the system, concept of cascade temperature, analysis, comparison with V.C. systems, applications.	9
IV	**Psychrometry of Air & Air Conditioning Processes:** Properties of	9

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moist air-Gibbs Dalton law, basic terminology, psychrometric chart, psychrometry of air-conditioning processes, mixing process, basic processes in conditioning of air.

Air- Conditioning Load Calculations: Outside and inside design conditions, sources of heating load, sources of cooling load, heat transfer through structure, solar radiation, electrical applications, infiltration and ventilation, heat generation inside conditioned space, apparatus selection.

Air Conditioning Systems with Controls & Accessories: Classifications, layout of plants, equipment selection, air distribution system, duct systems design, filters, refrigerant piping, design of summer air conditioning and winter air conditioning systems, temperature sensors, pressure sensors, humidity sensors, actuators, safety controls, accessories.

Text Books:

1. C.P. Arora, "*Refrigeration & Air Conditioning",* McGraw Hill Education (India) Pvt. Ltd.
2. Arora, Domukundwar, "*A course in Refrigeration & Air Conditioning",* Dhanpat Rai Publications.
3. R.C. Jordan, G.B. Priester, "*Refrigeration & Air Conditioning "*, Prentice Hall of India.

Reference Books:

1. W.F. Stockerand, J.W. Jones, "*Refrigeration & Air Conditioning"*, McGraw Hill Higher Education.
2. Manohar Prasad, "*Refrigeration & Air Conditioning "*, New Age International Pvt. Ltd.

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ME-704: INDUSTRIAL ENGINEERING AND PRODUCTION MANAGEMENT

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
2	2	0	3	40	60	100	3 hrs.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction:** Principles of management - definition and significance of management, basic functions of management – planning, organizing, staffing, directing and controlling. evolution of ie. engineers and organizational environment – social, economic, technological and political. social responsibility of engineers. **Organizational behaviour and human resource management:** Significance of OB, Role of leadership, personality and motivation. attitudes, values and perceptions at work. HR - importance, objectives and functions, job analysis and recruitment, selection and placement, training and development – forms of business organization.	**6**
II	**Work study:** Productivity definition, means of increasing productivity, productivity and work study work study - definition, aims, procedure for method study, selection of jobs, recording techniques, micro motion study, therbligs, cyclograph and chrono-cyclo-graph, principles of motion economy, design of work place layout, analysis in the form of chart, operation chart, flow process chart, flow diagram, string diagram, man machine chart, two hand chart, SIMO chart. – time study equipment, performance rating, allowances, number of cycles to be studied, determination of standard time, predetermined motion time systems. **Job evaluation, wages, incentives and welfare**: Job evaluation, objectives of job evaluation, Methods of job evaluation, non quantitative and quantitative. – characteristics of a good wage or a incentive systems, methods of wage payments, concept of wage incentive schemes, financial and non financial, Halsey premium plan, Merric's multiple piece rate system. working condition, service facilities, legal legislation – factories act, 1948.	**6**
III	**Ergonomics:** Definition, human technological system, multidisciplinary engineering approach, Biostatic mechanics, statics of rigid bodies, biodynamic mechanics, human body kinematics, kinetics, impact and	**6**

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	collision, bio-thermodynamics and bioenergetics.	
	Marketing feasibility analysis: Qualitative forecasting methods, quantitative forecasting models – forecast accuracy, long range forecast, short range forecast.	
IV	**Facilities layout and plant location:** Manufacturing facility layouts, analyzing manufacturing facility layouts, service facility layout. – factors affecting location decisions, multi facility location problem, ware house location problem, minimax location, gravity location problem.	6
	Inventory management and PPC: Views of inventories, nature of inventories, fixed order quantity systems, fixed order period systems, other inventory models, production planning and control- loading, scheduling, dispatching.	

Text books:

1. ILO, "*Introduction to work study*", Universal Book Corporation, Bombay, 1986.
2. Norman Gaither, Greg Frazier, "*Operations Management : Concepts, Techniques & Applications*", Cengage Learning.
3. Harold Koontz, Heinz Weihrich, "*Essentials of Management: An International and Leadership perspective*", McGraw Hill Education, 9th edition 2012

Reference Books:

1. Marvin E. Mundel, David L. Danner, "*Motion and Time Study*", Prentice Hall India.
2. Ralph M. Barnes, "*Motion and Time Study Design and Measurement of Work*", Wiley.
3. Mark S. Sanders, "*Human Factors in Engineering and Design*", McGraw Hill, New York, 1993.
4. Chandler Allen Phillips, "*Human Factors Engineering*", John Wiley and Sons, New York, 2000.

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AU-711: PROJECT WORK-I.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
0	0	4	2	50	50	100	3 hrs.

Suggested List of Activities/Projects :

Students are expected to complete a project in groups or alone as deemed fit by the faculty and department. They should work under supervision of Faculty member/s of department, or in collaboration with other departments, or preferably with Industry. The project should demonstrate application of the fundamentals learnt during the course of study and should also be innovative. Any of the following areas may be chosen for pursuing project work.

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ME-712: AUTOMATION AND ROBOTICS LAB.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	T	P/D	C	Sessional	End Semester Exam	Total	
0	0	2	1	30	20	50	3 hrs.

Note:
(1) Experiment No 1 includes 6 experiments on a single apparatus/assembly to demonstrate various automation principles.
(2) Experiment No. 3 includes 3 to 4 experiments to demonstrate different wear and friction conditions through various test rigs.

Suggested List of Experiments/Activities:

1. To study complete automation system having the following components :
   a. Linear conveyor
   b. Pick and place
   c. Rotary table
   d. Filling and packing
   e. Quality check
   f. Storage in warehouse
2. To program a robot for pick and place motion.
3. To study sliding and rolling friction and wear characteristics of different metals and non-metals at room as well as elevated temperatures using different tribo-meters like pin on disk, multi-tribo testers, etc..
4. To determine the weldability and extreme pressure properties of various lubricants using four-ball apparatus.
5. To study the pressure variation in a circular journal bearing.
6. To study and compare different types of anti-friction bearings.

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AU-713: INDUSTRIAL PRACTICAL TRAINING

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
0	0	0	2	50	50	100	3 hrs.

Note: Industrial training of 6 weeks duration attended after 6th semester for 6 weeks during summer vacations, and evaluated in 7th semester. The training may be in any of the following fields.

AU-714: AUTOMOTIVE POLLUTION & CONTROL LAB.

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	T	P/D	C	IA.	ESE.	Total	
0	0	2	1	30	20	50	3Hrs

Practicals as per the topics in the syllabus for the course will be conducted in the laboratory class.

Following is the suggested list of exercises out of which a minimum of 8-10 experiments must beperformed by a student during the semester:

LIST OF EXPERIMENTS:

1. Study of Pressure pickups, charge amplifier, storage oscilloscope and signal analysers used for IC engine testing.
2. Performance study of petrol and diesel engines both at full load and part load conditions.
3. Morse test on petrol and diesel engines.
4. Determination of compression ratio, volumetric efficiency and optimum cooling water
    flow rate in engines.
5. Heat balance test on an automotive engine.
6. Testing of 2 and 4 wheelers using chassis dynamometers.
7. Study of NDIR Gas Analyser and FID.
8. Study of Chemiluminescent NOx analyzer.
9. Measurement of HC, CO, CO2,N02 using exhaust gas analyzer.
10. Diesel smoke measurement.

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AU -708: TRACTOR AND FARM EQUIPMENTS

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE OBJECTIVE:

To provide knowledge about off road vehicles.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**General Design of Tractors:** Classification of tractors - Different types and purpose – Main components of tractor – Safety rules. Working attachment of tractors - Farm equipment - Classification - Auxiliary equipments - Trailers and body tipping mechanism.	**10**
II	**Control of the Tractor and Fundamentals of Engine Operation:** Tractor controls and the starting of the tractor engines - Basic notions and definition - Engine cycles – Operation of multi cylinder engines - General engine design - Basic engine performance characteristics.	**10**
III	**Engine Frame Work and Valve Mechanism of Tractor:** Cylinder and pistons – Connecting rods and crankshafts - Engine balancing - Construction and operation of the valve mechanism- Valve mechanism components - Valve mechanism troubles.	**9**
IV	**Cooling System, Lubrication System and Fuel System of A Tractor:** Cooling system- Classification - Liquid cooling system - Components, Lubricating system servicing and troubles - Air cleaner and turbo charger - Fuel tanks and filters - Fuel pumps	**10**

References:

1. Rodichev and Rodicheva. G, **“*Tractor and Automobiles”*,** MIR Publishers, 1987.
2. Kolchin. A and Demidov. V, **“*Design of Automotive engines for tractor”*,** MIR Publishers, 1972.
3. John B Lllzedaw , **“*Tractors and their power units”.***

AU -709:   HYBRID VEHICLES

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE OBJECTIVE:

Knowledge on the practical design of mechanisms and systems involved for dividing the power between the driving wheels. A fundamental knowledge on the factors influencing the driveline efficiency and dynamics can be acquired

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Hybrid Vehicles:** Performance characteristics of road vehicles, calculation of road load, predicting fuel economy, Grid connected hybrids. **Propulsion Methods:** DC motors-series wound, shunt wound. Compound wound andseparately excited motors AC motors - induction, synchronous, brushless DC motor, switched reluctance motors**.**	**10**
II	**Hybrid Architecture:** Series configuration- locomotive drives, series parallel switching, load tracking architecture. Pre transmission parallel and combined configurations-Mild hybrid, power assist, dual mode, power split, power split with shift, Continuously Variable transmission (CVT). Wheel motors.	**10**
III	**Hybrid Power Plant Specifications:** Grade and cruise targets, launching and boosting, braking and energy recuperation, drive cycle implications, engine fraction-engine downsizing and range and performance, usage requirements. **Sizing the Drive System**: Matching electric drive and ICE, sizing the propulsion motor, sizing power electronics	**9**
IV	**Energy Storage Technology:** Battery basics, lead-acid battery, different types of batteries, battery parameters. **Fuel Cells:** Fuel cell characteristics, fuel cell types - alkaline fuel cell, proton exchange membrane, direct methanol fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, hydrogen storage	**10**

	systems, reformers, fuel cell EV, super and ultra capacitors, flywheels.	

References:

1.Chris Mi and M. Abul Masrur, *"Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives"*.
2. Wei Liu, Introduction to *"Hybrid Vehicle System Modeling and Control; Wiley publication"*.

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AU -710:   MOTOR VEHICLE & ENVIRONMENT PROTECTION

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE OBJECTIVE:

The course provides a comprehensive knowledge in environmental science, environmental issues and the management. To acquire knowledge about environmental pollution- sources, effects and control measures of environmental pollution.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	Emission Standards and Regulations, Emissions Measurement and Testing Procedures– Exhaust Emissions Testing for Light-Duty Vehicles, Exhaust Emissions Testing for Motorcycles and Mopeds, Exhaust Emissions Testing for Heavy-Duty Vehicle Engines, crankcase emissions, evaporative emissions, re-fueling emissions, On-road exhaust emissions. Vehicle Emission Factors – Gasoline-fueled vehicles, diesel-fueled vehicles, Motorcycles.	10
II	Emissions Control Technology for Gasoline-Fueled Vehicles (Spark-Ignition Engines –Air-Fuel Ratio, Electronic Control Systems, Catalytic Converters, Crankcase Emissions and Control, Evaporative Emissions and Control, Fuel Dispensing/Distribution Emissions and Control. Emissions Control Technology for Diesel-Fueled Vehicles (Compression-Ignition Engines) – Engine Design, Exhaust After treatment. Emission Control Options and Costs – Gasoline- Fueled Passenger Cars and Light-Duty Trucks, Heavy-Duty Gasoline-Fueled Vehicles, Motorcycles, Diesel-Fueled Vehicles.	10
III	Inspection Procedures for Vehicles with Spark-Ignition Engines – Exhaust Emissions, Evaporative Emissions, Motorcycle White Smoke Emissions. Inspection Procedures for Vehicles with Diesel Engines Institutional Setting for Inspection and Maintenance: Centralized I/M, Decentralized I/M, Comparison of Centralized and Decentralized I/M Programs, Inspection Frequency, Vehicle Registration, Roadside Inspection Programs, Emission Standards for Inspection and Maintenance Programs, Costs and Benefits of Inspection and Maintenance Programs.	9

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IV	Fuel Options for Controlling Emissions: Gasoline – Lead and Octane Number, Fuel Volatility, Olefins, Aromatic Hydrocarbons, Distillation Properties, Oxygenates, Sulfur, Fuel Additives to Control Deposits, Reformulated Gasoline. Diesel – Sulfur Content, Cetane Number, Aromatic Hydrocarbons, Other Fuel Properties, Fuel Additives. Alternative Fuels: Natural Gas, Liquefied Petroleum Gas (LPG), Methanol, Ethanol, Biodiesel, Hydrogen. Factors Influencing the Large-Scale Use of Alternative Fuels, Cost, End-Use Considerations, Life-Cycle Emissions.	10

Text Books:

1. Faiz, Weaver, Walsh, *"Air Pollution from Motor Vehicles, Standards and Technologies for Controlling Emissions",* The World Bank Washington

AU -801: VEHICLE BODY ENGINEERING

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE OBJECTIVE:

At the end of the course, the students will be able to have a sound knowledge for the design of the vehicles body to give maximum comfort for the passengers and exposed to the methods of streamlining the vehicles body to minimize drag.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Car Body Details**: Types: saloon, convertibles, limousine, estate car, racing and sports car. Visibility: regulations, driver's visibility, tests for visibility, methods of improving visibility and space in cars. Safety: safety design, safety equipments for cars. Car body construction; design criteria, prototype making, initial tests, crash tests on full scale model, Dummies and Instrumentation. **Bus Body Details**: Types: mini bus, single-decker, double-decker, two level and articulated bus. Bus body layout; floor height, engine location, entrance and exit location, seating dimensions. Constructional details: frame construction, double skin construction, types of metal sections used, Regulations, Conventional and integral type construction.	11
II	**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 forces and moments. **Ergonomics**: Man machine system, anthropometry data, and anthropometric considerations in the design of seat, controls and displays, gear lever, steering wheel, foot controls, etc. Dimensions of driver's seat in relation to controls. Visibility: regulations, driver's visibility, tests for visibility, methods of improving visibility in vehicles. Effect of Noise, vibration and heat on human body and their control, Driver Cab design.	10
III		

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	Commercial Vehicle Details: Types of body; flat platform, drop side, fixed side, tipper body, tanker body, Light commercial vehicle body types. Special Purpose Vehicle Details: Various types, Needs and constructional details - Fire station vehicle: tankers, pumping vehicles, ladder vehicle; Concrete mixer transport vehicles; Ambulance; Towing vehicle; Road trains. Off road vehicles. **Safety:** Safety aspects in vehicle bodies. Safety equipments for cars – Anti roll bars, Roll over bar, Collapsible steering, multistage bumpers, side impact beams in doors, collision crumple zones. Seat belts, Air bags, Bucket seats with headrest. Laminated/toughened glasses. Anti jamming door locks. Fibre fuel tanks. Testing of vehicle bodies for the safety.	**9**
IV	**Body Loads:** Types of load carrying structures -closed, integral, open, flat types. Calculation of loading cases- static, symmetric and asymmetric vertical loads in a car, longitudinal load, and different loading situations. Load distribution, stress analysis of structure, body shell analysis. **Body**: Body design requirement, car body space nomenclature. Body frame of passenger car and commercial vehicle. Different type of car door and window regulator, car roof, wind shield, car seats and their various design. BODY MATERIALS: Different types of ferrous and non-ferrous materials used in vehicle such as cast iron, Steel. Alloy steel, plastic, G.R.P., Glass etc. and their properties. Corrosion, anticorrosion methods. Selection of paint and painting process.	**9**

Text Books:

1. J.Powloski - *"Vehicle Body Engineering"* ,- Business Books Ltd, London -1989

References:

1. Giles.J.C. - "Body construction and design" - Liiffe Books Butterworth & Co. - 1971.
2. John Fenton - "Vehicle Body layout and analysis" - Mechanical Engg. Publication Ltd., London – 1982.
3. Braithwaite.J.B. - "Vehicle Body building and drawing" - Heinemann Educational Books Ltd., London – 1977.
4. Crouse W and Anglin D, Automotive Mechanics Tata Mcgraw hill publication 10th edition, 2004
5. Body Engineering -Sydney F Page
6. Vehicle body engineering - Gilcs J Pawlowsk

AU -802:   ENTREPRENEURSHIP DEVELOPMENT

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE OBJECTIVE:

After successful completion of this course, the students should be able to analyze himself on entrepreneurial traits and various business opportunities.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Entrepreneurship**: Historical Perspective of Entrepreneurship-Entrepreneur-Traits of Entrepreneurs-Types of Entrepreneurs-Intrerpreneur-Difference between Entrepreneur and Intrepreneur-Entrepreneurship in Economic growth, Factors affecting Entrepreneurial Growth, Major motives influencing Entrepreneur.	**9**
II	**Business:** Small Enterprises-definition, Classification- Characteristics, Web and e business - Ownership structure-Project Formulation- Sources of Information- Steps involved in setting up a business- -Identifying, Selecting a good business opportunity, Market survey and research, Techno economic feasibility assessment-Preliminary Project report – Project Appraisal – Project implementation-Network Analysis, Techniques of PERT/CPM.	**11**
III	**Marketing & Growth Strategies:** Principles of Marketing, Assessment of market needs, Demand Forecasting, Product Life cycle-Sales Promotion Strategies- Product mix- Advertising- Distribution Channels. Growth Strategies- Expansion, Diversification, Joint venture, Merger, Sub-contracting	**9**
IV	**Institutional Support to Entrepreneurs:** Institutional support to Entrepreneurs-Government policy for small scale industries, Institutions for entrepreneurial growth –various schemes-Self Help Group-Sickness in industry-causes-steps for correction and rehabilitation (Field work-Collection of information on schemes of Entrepreneurial Support and Presentation).	**10**

Text Books:

1. Khanka, S.S., **"*Entrepreneurial Development"*,** S.Chand & Co Ltd, New Delhi, 1999.
2. Philip Kotler, **"*Principles of Marketing"*,** Prentice Hall of India, 1995.
3. Lamer Lee and Donald W.Dobler, **"*Purchasing and Materials Management"*,** Tata McGraw Hill, 1996.

Reference Books:

1. EDII –Faculty and External Experts, **"*A Hand Book of new Entrepreneurs"*,** Published by Entrepreneurship Development Institute of India, Ahmedabad, 1986
2. Saravanavel, P., **"*Entrepreneurial Development"*,** Ess Pee Kay Publishing

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AU-803: FLEXIBLE MANUFACTURING SYSTEMS

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE OBJECTIVE:

FMS are to approach the efficiencies and economies of scale normally associated with mass production, and to maintain the flexibility required for small- and medium-lot-size production of a variety of parts.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Production Systems:** Types of production-Job Shop, Batch & Mass production-Functions in Manufacturing- Organization and Information Processing in Manufacturing-Plant Layout-Batch production – Work in Progress inventory, Scheduling, Problems.	9
II	**GROUP TECHNOLOGY Group Technology:** Formation of Part Families - Part Classification - Coding Systems-Optiz, Multi Class - Production Flow Analysis – Machine Cells Design -Clustering Methods-Modern Algorithms- Benefits of GT-system planning objective, guide line, system definition and sizing-human resources-objective, staffing, supervisor role.	10
III	**Flexible Manufacturing System:** Introduction-Evolution-Definition-Need for FMS-Need for Flexibility-Economic Justification of FMS Application Criteria-Machine tool Selection & Layout-Computer Control System- Data files-Reports-Planning the FMS-Analysis Methods For FMS- Benefits and Limitations.	9
IV	**Flexible Manufacturing Cells:** Introduction-Cell Description and Classifications-Unattended Machining–Component Handling &storage system-cellular versus FMS-System- simulation, hardware configuration-Controllers, Communication networks- Lean production and agile manufacturing.	11

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Text Books:

1. William W.Luggen, **"*Flexible Manufacturing Cells and Systems*",** Prentice Hall, NJ,1991.

AU -804: INDUSTRIAL SAFETY AND ENVIRONMENT

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3Hrs**

COURSE OBJECTIVE:

To promote and maintain high standards, safety, work quality and working practices for the industrial rope access industry and maintain a high standard of industrial rope access activities in terms of safety and work quality.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Accident Prevention:** Definitions and theories:- Accident – Injury – unsafe act – unsafe condition – Dangerous occurrence –Theories and principles of accident causation – Cost of accidents – Accident reporting and investigations – Safety committees – need – types – advantages. Safety Education and training- Importance - various training methods – Accident prevention – Motivating factors – Safety suggestion schemes. Safety performance – Definitions connected with measuring safety performance as per Indian and International standards.	**10**
II	**Safety in Material Handling:** General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers. Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms. Selection, operation and maintenance of Industrial Trucks – Mobile Cranes – Tower crane. **Safety in Chemical Industries:** Safety in the design process of chemical plants- Safety in operational and maintenance – Exposure of personnel, Operational activities and hazards – Safety in storage and Handling of chemical and gases – Hazards during transportation – pipeline transport – safety in chemical laboratories. Specific safety consideration for Cement, paper, pharmaceutical, petroleum, petro- chemical, rubber, fertilizer and distilleries.	**11**
III	**Environmental Impact Assessment:** Evolution of EIA – Concepts – Methodologies – Screening – Scoping — Checklist, Rapid and Comprehensive EIA – Legislative and Environmental Clearance procedure in India – Prediction	**9**

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	tools for EIA. Assessment of Impact – Air – Water – Soil – Noise-Biological. Socio cultural environment – Public participation – Resettlement and Rehabilitation, Documentation of EIA .	
IV	**Regulations for Health, Safety and Environment:** Factories act and rules; Indian explosive act - Gas cylinder rules. Environmental pollution act - Indian petroleum act and rules. Oil industry safety directorate (OISD) - Indian Electricity act and rules. Mines act and rules - Indian motor vehicles act and rules.	**9**

Text Books:

1. Handlin, W**., "*Industrial Hand Book"*,** McGraw-Hill, 2000.
2. Anton, T. J., **"*Occupational safety and health management"*,** (2nd ed.). New York, NY: McGraw Hill, Inc, 1989.

References:

1. Heinrich, H.W., **"*Industrial Accident Prevention"*,** McGraw-Hill, 1980
2. Rudenko, N., **"*Material Handling Equipments"*,** Mir Publishers, Moscow, 1981.
3. Lees, F.P., **"*Loss Prevention in Process Industries"*,** Butterworths, NewDelhi, 1986.
4. Canter, R. L., **"*Environmental Impact Assessment"*,** McGraw Hill.

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AU -805: VEHICLE DESIGN AND DATA CHARACTERISTICS

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	T	P/D	C	Sessional	End Semester	Total	
3	0	0	3	40	60	100	3Hrs

COURSE OBJECTIVE:

At the end of the course, the students will be able to have a sound knowledge for the design of the vehicles body to give maximum comfort for the passengers and exposed to the methods of streamlining the vehicles body to minimize drag.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	Assumptions to be made in designing a vehicle, Range of values for Gross Vehicle Weight, Frontal Area, maximum speed, maximum acceleration, gradability in different gears, Basics of Automobile Design.	9
II	**Resistance to vehicle motion:** Calculation, Tabulation and Plotting of Curves for Air and Rolling Resistances at various vehicle speeds, Calculation and Plotting of Driving force, Power requirement for different loads and acceleration, Maximum Power calculation.	10
III	**Performance curves:** Calculation, Tabulation and Plotting of Torque and Mechanical Efficiency for different vehicle speeds, Interpolation of Pressure – Volume diagram, Calculation of frictional Mean Effective Pressure, Calculation of Engine Cubic Capacity, Bore and Stroke Length.	10
IV	Connecting rod length to Crank Radius Ratio, Plotting of Piston Velocity and Acceleration against Crank Angle, Plotting Gas force, inertia force and Resultant force against Crank Angle, Turning Moment and Side Thrust against Crank Angle.	10

Text Books:

1. N. K. Giri, *"Automotive Mechanics, Khanna Publishers",* New Delhi, 2005.

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2. Heldt, P.M., *"High Speed Combustion Engines",* Oxfore and I.B.H. Publishing Co.,Kolkata, 2002.

Reference Books:

1.R.B.Gupta, *"Automobile Engineering".*

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AU-806: PRECISION ENGINEERING

Teaching Scheme			Credit	Marks			Duration of End semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester**	**Total**	
3	0	0	3	40	60	100	3Hrs

COURSE OBJECTIVE:

To create a highly precise movement and reduce the dispersion of the product's or part's function. To Eliminate fitting and promote assembly, especially automatic assembly and reduce the initial cost and running cost.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction**: Accuracy & precision – Need – application precision machining –Tool based Micro & Ultra precision Machining grinding – Thermal effects – Materials for tools and machine elements – carbides – ceramic, CBN & diamond.	10
II	**Tolerance and Fits:** Tolerance – Zone – fits – Variation – Hole & shaft system – limits – expected Accuracy of machining processes – Selective assembly – gauges acceptance tests for machine tools.	10
III	**Ultra Precision Machine Elements:** Introduction – Guide ways – Drive systems – Spindle drive – preferred numbers – Rolling elements – hydrodynamic & hydrostatic bearings – pneumatic bearings.	9
IV	**Error Control:** Error – Sources – Static stiffness – Variation of the cutting force – total compliance –Different machining methods – Thermal effects – heat source – heat dissipation –Stabilization – decreasing thermal effects – forced vibration on accuracy – clamping & setting errors – Control – errors due to locations – principle of constant location surfaces.	10

Text Books:

1. Nakazawa, H. *"Principles of Precision Engineering",* Oxford University Press, 1994.
2. Precision Engineering – R.L. Murthy.

References:

1. Institute of Physics Publishing, Bristol and Philadelphia, Bristol, BSI 6BE U.K

AU-807: PROJECT WORK-II

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
0	0	16	8	50	50	100	3 hrs.

Note: Project Work during last semester duration is to be carried out by the student under the joint supervision of faculty advisers from institution as well as from the industry. The work should demonstrate *higher (than previous semesters)* standards of design, analysis and fabrication capability of the student learnt during the course. The students may work in groups, as deemed fit by the faculty/supervisors.

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AU-808: INDUSTRIAL PROJECT

Teaching and Examination Scheme:

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
0	0	16	8	50	50	100	3 hrs.

Note: Industrial Project of Four months duration is to be carried out by the student in   industry under the joint supervision of faculty advisers from institution as well as from the industry.