Departmental Curriculum Structure

1st Semester

First Year First Semester							
Mandatory Induction Program- 3 weeks duration							
Sl No.	**Category**	**Subject Code**	**Subject Name**	**Total No. of contact hours**			**Credits**
				L	**T**	**P**	
Theory							
1	Basic Science course	BS-PH101	Physics-I	3	1	0	4
2	Basic Science course	BS-M102	Mathematics –IB	3	1	0	4
3	Engineering Science Courses	ES-EE101	Basic Electrical Engineering	3	1	0	4
	Total Theory			**9**	**3**	**0**	**12**
Practical							
1	Basic Science course	BS-PH191	Physics-I Laboratory	0	0	3	1.5
2	Engineering Science Courses	ES-EE191	Basic Electrical Engineering Laboratory	0	0	2	1
3	Engineering Science Courses	ES-ME192	Workshop/Manufacturing Practices	1	0	4	3
	Total Practical			**1**	**0**	**9**	**5.5**
	Total of First Semester			**10**	**3**	**9**	**17.5**

2nd Semester

First Year Second Semester							
Sl No.	**Category**	**Subject Code**	**Subject Name**	**Total No. of contact hours**			**Credits**
				L	**T**	**P**	
Theory							
1	Basic Science course	BS-CH201	Chemistry-I (Gr-A)	3	1	0	4
2	Basic Science course	BS-M202	Mathematics –IIB	3	1	0	4
3	Engineering Science Courses	ES-CS201	Programming for Problem Solving	3	0	0	3
4	Humanities and Social Sciences including Management courses	HM-HU201	English	2	0	0	2
	Total Theory			**11**	**2**	**0**	**13**
Practical							
1	Basic Science course	BS-CH291	Chemistry-I Laboratory	0	0	3	1.5
2	Engineering Science Courses	ES-CS291	Programming for Problem Solving	0	0	4	2
3	Engineering Science Courses	ES-ME291	Engineering Graphics & Design (Gr-A)	1	0	4	3
4	Humanities and Social Sciences including Management courses	HM-HU291	Language Laboratory	0	0	2	1
	Total Practical			**1**	**0**	**13**	**7.5**
	Total of Second Semester			**12**	**2**	**13**	**20.5**

3rd Semester

Sl No.	Category	Subject Code	Subject Name	Total no. of contact hours			Credits
				L	T	P	
Theory							
1	Basic Science Course	BS-M301	Mathematics III (PDE, Probability & Statistics)	3	1	0	4
2	Basic Science Course	BS-BIO301	Biology	3	0	0	3
3	Engineering Science Courses	ES-ECE301	Basic Electronics Engineering	3	0	0	3
4	Engineering Science Courses	ES-AUE301	Engineering Mechanics	3	1	0	4
5	Professional Core Courses	PC-AUE301	Applied Thermodynamics	3	1	0	4
6	Professional Core Courses	PC-AUE302	Manufacturing Processes	4	0	0	4
	Total Theory			**19**	**3**	**0**	**22**
Practical							
1	Professional Core Courses	PC-AUE391	Machine Drawing	0	0	3	1.5
	Total Practical			**0**	**0**	**3**	**1.5**
	Total of Third Semester			**19**	**3**	**3**	**23.5**

4th Semester

Second Year Fourth Semester							
Sl No.	**Category**	**Subject Code**	**Subject Name**	**Total No. of contact hours**			**Credits**
				L	**T**	**P**	
Theory							
1	Engineering Science Courses	ES-AUE401	Materials Engineering	3	0	0	3
2	Professional Core courses	PC-AUE401	Strength of Materials	3	1	0	4
3	Professional Core courses	PC-AUE402	Fluid Mechanics & Fluid Machines	4	0	0	4
4	Professional Core courses	PC-AUE403	Theory of Machine	3	1	0	4
5	Professional Core courses	PC-AUE404	Metrology and Instrumentation	3	0	0	3
	Total Theory			**16**	**2**	**0**	**18**
Practical							
1	Professional Core courses	PC-AUE 491	Manufacturing & Testing Lab	0	0	3	1.5
2	Mandatory courses	MC481	Environmental Science	-	-	2	0
	Total Practical			**0**	**0**	**5**	**1.5**
	Total of Fourth Semester			**16**	**2**	**5**	**19.5**

5th Semester

Third Year Fifth Semester							
Sl No.	Category	Subject Code	Subject Name	Total No. of contact hours			Credits
				L	T	P	
Theory							
1	Professional Core courses	PC-AUE501	Automotive Engines	3	0	0	3
2	Professional Core courses	PC-AUE502	Automotive Body & Chassis Engineering	3	0	0	3
3	Professional Core courses	PC-AUE503	Heat Transfer	3	1	0	4
4	Professional Core Courses	PC-AUE 504	Design of Machine Element	3	1	0	4
5	Humanities and Social Sciences including Management courses	HM-HU 511A/ HM-HU 511B	Values & Ethics / Education, Technology & Society	3	0	0	3
	Total Theory			**15**	**2**	**0**	**17**
Practical/ Sessional							
1	Professional Core courses	PC-AUE591	Fluid Mechanics & Heat Transfer Lab	0	0	3	1.5
2	Professional Core courses	PC-AUE592	Automobile Engineering Lab I (Engine & Chassis Component Lab)	0	0	3	1.5
3	Professional Core courses	PC-AUE593	Automobile Engineering Lab II (ETPM Lab)	0	0	3	1.5
4	Project (Mini Project)	PW-AUE581	Project-I (30 hrs. Total)	0	0	0	1
	Total Practical			**0**	**0**	**9**	**5.5**
	Total of Fifth Semester			**15**	**2**	**9**	**22.5**

List of Humanities and Social Sciences including Management courses

HM-HU511A: Values & Ethics
HM-HU511B: Education Technology & Society

6th Semester

Third Year Sixth Semester							
Sl No.	**Category**	**Subject Code**	**Subject Name**	**Total No. of contact hours**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Core Courses	PC-AUE 601	Automotive Transmission	3	0	0	3
2	Professional Core Courses	PC-AUE 602	Hybrid & Electric Vehicles	3	0	0	3
3	Professional Elective Courses	PE-AUE611A/ PE-AUE611B	Elective-I	3	0	0	3
5	Humanities and Social Sciences including Management courses	HM-HU611A/ HM-HU611B	Humanities-II	3	0	0	3
6	Mandatory Courses	MC-601	Essence of Indian Traditional Knowledge	-	1	-	0
	Total Theory			**12**	**1**	**0**	**12**
Practical/Sessional							
1	Professional Core Courses	PC-AUE 691	Automobile Engineering Lab III (Automotive Design Lab)	0	0	3	1.5
2	Professional Core Courses	PC-AUE 692	Automobile Engineering Lab IV (Vehicle Maintenance Lab)	0	0	3	1.5
2	Project (or Summer Internship)	PW-AUE 681	Project-II (90 hrs. Total)	0	0	0	3
	Total Practical			**0**	**0**	**6**	**6**
	Total of Sixth Semester			**12**	**1**	**6**	**18**

List of Professional Elective courses

PE-AUE611A: Electronic Vehicle Management System
PE-AUE611B:Transport Management &Motor Vehicles Act

List of Humanities and Social Sciences including Management Courses

HM-HU 611A: Introduction to Industrial Management
HM-HU611B: Quantitative Methods for Decision Making

Department of Automobile Engineering

7th Semester

Fourth Year Seventh Semester							
Sl No.	Category	Subject Code	Subject Name	Total No. of contact hours			Credits
				L	T	P	
Theory							
1	Professional Core courses	PC-AUE701	Vehicle Dynamics	3	0	0	3
2	Professional Elective Courses	PE-AUE 711A/ PE-AUE711B	Elective II	3	0	0	3
3	Professional Elective Courses	PE-AUE 712A/ PE-AUE712B	Elective-III	3	0	0	3
4	Open Elective Courses	OE-AUE711A/ OE-AUE711B/ OE-AUE711C	Open Elective-I	3	0	0	3
5	Humanities and Social Sciences including Management courses	HM-HU701	Economics for Engineers	2	0	0	2
	Total Theory			**14**	**0**	**0**	**14**
Practical/Sessional							
1	Professional Core Courses	PC-AUE791	Automobile Engineering Lab V (Automotive Electrical & Electronics Lab)	0	0	3	1.5
2	Project	PW-AUE781	Project-III	0	0	6	3
	Total Practical			**0**	**0**	**9**	**4.5**
	Total of Seventh Semester			**14**	**0**	**9**	**18.5**

List of Professional Elective courses

PE-AUE711A:Alternate Fuels and Energy Systems
PE-AUE711B:CAD/CAM and Modern Manufacturing Methods
PE-AUE 712A: Automotive Component System
PE-AUE712B:Two and Three Wheelers

List of Open Elective courses

OE-AUE 711A: Quality Control & Reliability Engineering
OE-AUE711B:Machine Learning
OE-AUE711C:Cloud Computing

8th Semester

Fourth Year Eighth Semester							
Sl No.	Category	Subject Code	Subject Name	Total No. of contact hours			Credits
				L	T	P	
Theory							
1	Professional Elective Courses	PE-AUE 811A/ PE-AUE811B	Elective IV	3	0	0	3
2	Professional Elective Courses	PE-AUE812A/ PE-AUE 812B/ PE-AUE812C	Elective V	3	0	0	3
3	Open Elective Courses	OE-AUE811A/ OE-AUE 811B/ OE-AUE811C	Open Elective-II	3	0	0	3
4	Open Elective Courses	OE-AUE 812A/OE-AUE812B	Open Elective-III	3	0	0	3
	Total Theory			**12**	**0**	**0**	**12**
Practical/Sessional							
1	Professional Core Courses	PW-AUE881	Comprehensive Viva Voce	0	0	0	2
2	Project	PW-AUE882	Project-IV	0	0	12	6
	Total Practical			**0**	**0**	**12**	**8**
	Total of Eighth Semester			**12**	**0**	**12**	**20**

List of Professional Elective courses

PE-AUE 811A: Off Road Vehicles
PE-AUE 811B: Automotive Air Conditioning

PE-AUE 812A: Non-Destructive Testing Methods
PE-AUE 812B: Noise, Vibrations and Harshness
PE-AUE 812C: Finite Element Method & its applications

List of Open Elective courses

OE-AUE 811A: Tribology
OE-AUE 811B: Internet of Things OE-AUE 811C: Soft Computing

OE-AUE 812A: Computational Fluid Dynamics
OE-AUE 812B: Entrepreneurship Development
OE-AUE 812C: Robotics and Robot Application

Syllabus & Course Outcomes

1st Semester

BS-PH101:Physics

Course Code	**:**	BS-PH101
Course Title	**:**	Physics-I
L-T-P	:	3-1-0
Category	**:**	Basic Science Courses
Semester	:	First
Credit	:	4
Stream	**:**	B. Tech. (AUE)
Full Marks	:	100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students Will be able to:

CO1	Learn basic concepts of quantum physics, simple quantum mechanics calculations; Macrostate, Microstate, Density of states, Qualitative treatment of MB, FD and BE statistics.
CO2	Solve problems including constraints & friction. Basic ideas of vector calculus and partial differential equations. Harmonic oscillator. Damped harmonic motion forced oscillations and Resonance.
CO3	Learn the application of wave properties of light Interference, Diffraction and Polarization; Lasers: Principles and working of laser
CO4	Learn Maxwell's equations. Polarization, Dielectrics; Magnetization, magnetic-hysteresis.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	2	-	-	2	1	2
CO2	3	3	3	2	2	1	2	-	-	2	1	2
CO3	3	3	3	3	2	1	2	-	-	2	1	2

CO4	3	3	3	2	2	1	2	-	-	2	1	2

Syllabus (BS-PH 101)

UNIT 1. Mechanics

Problems including constraints & friction. Basic ideas of vector calculus and partial differential equations. Potential energy function F = -grad V, equipotential surfaces and meaning of gradient. Conservative and non-conservative forces. Conservation laws of energy & momentum. Non-inertial frames of reference. Harmonic oscillator; Damped harmonic motion forced oscillations and resonance. Motion of a rigid body in a plane and in 3D. Angular velocity vector. Moment of inertia.

UNIT 2. Optics

Distinction between interference and diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits (only the expressions for max; min, & intensity and qualitative discussion of fringes); diffraction grating (resolution formulae only), characteristics of diffraction grating and its applications. Polarization: Introduction, polarization by reflection, polarization by double reflection, scattering of light, circular and elliptical polarization, optical activity. Lasers: Principles and working of laser – population inversion, pumping, various modes, threshold population inversion with examples

UNIT 3. Electromagnetism and Dielectric Magnetic Properties of Materials

Maxwell's equations, Polarization, permeability and dielectric constant, polar and non-polar Dielectrics, internal fields in a solid, Clausius-Mossotti equation (expression only), applications of dielectrics. Magnetization: permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

UNIT 4. Quantum Mechanics

Introduction to quantum physics, black body radiation, explanation using the photon concept, Compton effect, de Broglie hypothesis, wave-particle duality, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in box, quantum harmonic oscillator, hydrogen atom.

UNIT 5. Statistical Mechanics

Macrostate, Microstate, Density of states, Qualitative treatment of Maxwell Boltzmann, Fermi-Dirac and Bose-Einstein statistics.

Books

Learning Resources:

1.Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited
2. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker, Wiley
3. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press Engineering
4. Mechanics (In SI Units) (SIE), S. Timoshenko,D.H. Young, J.V. Rao, Sukumar Pati, McGraw Hill Education
5. Classical mechanics, Narayan Rana, Pramod Joag, McGraw Hill Education

6. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education
7. Engineering Mechanics, M.K. Harbola, Cengage India
8. An Introduction to Mechanics (SIE), David Kleppner, Robert Kolenkow, McGraw Hill Education
9. Principles of mechanics, John L. Synge and Byron A. Griffith, New York, McGraw-Hill
10. Mechanics (Dover Books on Physics), J. P. Den Hartog, Dover Publications Inc.
11. Engineering Mechanics: Dynamics, L.G. Kraige J.L. Meriam, Wiley
12. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, Robert Eisberg, Robert Resnick, Wiley
13. Introduction to Quantum Mechanics, J. Griffiths David, Pearson Education
14. Modern Quantum Mechanics, J. J. Sakurai, Cambridge University Press
15. Optics, Hecht, Pearson Education
16. Optics, Ghatak, McGraw Hill Education India Private Limited
17. Fundamentals of Statistical and Thermal Physics, Reif, Sarat Book Distributors
18. Statistical Mechanics, Pathria, Elsevier
19. Statistical Physics, L.D.Landau , E.M. Lifshitz, Butterworth- Heinemann

BS-M101: Mathematics - IB

Course Code : BS-M102
Course Title: Mathematics - IB
L-T-P: 3-1-0
Category: Basic Science Courses
Semester: First
Credit : 4
Stream: B. Tech (AUE).
Full Marks: 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Apply the concept and techniques of differential and integral calculus to determine curvature and evaluation of different types of improper integrals.
CO2	Understand the domain of applications of mean value theorems in engineering problems.
CO3	Learn the tools of power series and Fourier series to analyze engineering problems and apply the concept of convergence of infinite series in many approximation techniques in engineering disciplines.
CO4	Apply the knowledge for addressing the real-life problems which comprise of several variables or attributes and identify extremum points of different surfaces of higher dimensions.
CO5	Learn and apply the concept of Eigen values, Eigen vectors, Diagonalization of matrices and Orthogonalization in inner product spaces for understanding physical and engineering problems.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	3	2	2	2	2	-	-	1	2	2
CO2	3	3	2	2	2	2	-	-	2	-	1	2
CO3	3	3	3	2	2	-	2	-	2	1	-	1
CO4	3	3	2	2	3	2	-	-	-	-	2	2
CO5	3	3	2	2	2	2	1	-	1	1	2	1

Syllabus (M101)

Module1: Calculus (Integration)[8L]

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module2: Calculus (Differentiation) [6L]

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders; Indeterminate forms and L Hospital's rule; Maxima and minima.

Module3: Sequence and Series[11L]

Convergence of sequence and series, tests for convergence; Power Series, Taylor's Series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Module4: Multivariate Calculus[9L]

Limit, continuity and partial derivatives, Directional derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, Curl and Divergence.

Module 5: Matrices [8L]

Inverse and rank of a matrix, Rank-nullity theorem; System of linear equations; Symmetric, Skew-symmetric and Orthogonal matrices; Determinants; Eigen Values and Eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal Transformation.

Books

Learning Resources

1. Reena Garg, Engineering Mathematics-I, Khanna Publishers.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3. Michael Greenberg, Advanced Engineering Mathematics, Pearson.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
5. Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.
6. Veerarajan T., Engineering Mathematics for first year, Tata McGraw- Hill, NewDelhi.

ES-EE-101: Basic Electrical Engineering

Course Name: Basic Electrical Engineering
Course Code: ES-EE101
Category: Engineering Science Courses
Course Title: Basic Electrical Engineering
Semester: First
L-T-P: 3-1-0
Credit: 4

Course Outcome (CO)

Students will be able to:

CO 1	To describe fundamentals of DC and AC circuits
CO 2	To explain the operating principle of transformer
CO 3	To illustrate construction, working of Electrical Machines
CO 4	To classify different power converters and installation process

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	2	2	2	1	-	2	2	2	3
CO 2	3	2	2	2	2	2	1	-	2	2	2	3
CO 3	3	2	2	2	2	2	1	-	2	2	2	3
CO 4	3	2	2	2	2	2	1	-	2	2	2	3

Syllabus (ES-EE-101)

Module 1: DC Circuits (8 hours)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits (8 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits

Consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Transformers (6 hours)

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module 4: Electrical Machines (8 hours)

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic cand speed control of separately excited dc motor. Construction and working of synchronous generators.

Module 5: Power Converters (6 hours)

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module 6: Electrical Installations (6 hours)
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Books

Learning Recourses:

1. Ritu Sahdev, Basic Electrical Engineering, Khanna Book Publishing Co. (P) Ltd., Delhi.
2. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGrawHill, 2010.
3. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
4. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
5. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
6. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

BS-PH191: Physics Laboratory

Course Code	:	BS-PH191
Course Title	:	Physics-I Laboratory
L-T-P	:	0-0-3
Category	:	Basic Science Courses
Semester	:	First
Credit	:	1.5
Stream	:	B. Tech. (All branches except EE and ECE).
Full Marks	:	100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Ability to increase power of observation and reasoning and to think and work with precision and accuracy in daily life. Use Slide calipers and screw gauge, familiar with concept of Band gap of semiconductor and dielectric constant
CO2	Get the opportunity to verify the validity of various laws taught in curriculum, Familiar with dispersive power of the material of A prism, Newton's ring, Planck constant
CO3	Familiar with Hall coefficient of a semiconductor Electron spin resonance spectrometer, young's modulus, Poiseuille's capillary flow method for viscosity measurement.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	3	1	2	-	-	2	1	2
CO 2	3	3	3	3	3	1	2	-	-	2	1	2
CO 3	3	3	3	3	3	1	2	-	-	2	1	2

Syllabus (BS-PH191)

Experiments in Optics

1. Determination of dispersive power of the material of a prism
2. Determination of wavelength of a monochromatic light by Newton's ring
3. Determination of wavelength of a monochromatic light by Fresnel's bi-prism
4. Determination of wavelength of the given laser source by diffraction method

Electricity & Magnetism Experiments

1. Determination of thermos-electric power of a given thermocouple.
2. Determination of specific charge (e/m) of electron by J.J. Thompson's method.
3. Determination of dielectric constant of a given dielectric material.
4. Determination of Hall coefficient of a semiconductor by four probe method.
5. To study current voltage characteristics, load response, a real characteristic and spectral response of a photovoltaic solar cell.
6. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance.
7. Determination of unknown resistance using Carey Foster's bridge
8. Study of Transient Response in LR, RC and LCR circuits using expeves
9. Generating sound from electrical energy using expeves

Experiments in Quantum Physics

1. Determination of Stefan-Boltzmann constant.
2. Determination of Planck constant using photocell.
3. Determination of Lande-g factor using Electron spin resonance spectrometer.
4. Determination of Rydberg constant by studying Hydrogen spectrum.
5. Determination of Band gap of semiconductor.
6. To study current voltage characteristics, load response, a real characteristic and spectral response of a photovoltaic solar cell.

Miscellaneous Experiments

1. Determination of Young's modulus of elasticity of the material of a bar by the method of flexure
2. Determination of bending moment and shear force of a rectangular beam of uniform cross-section
3. Determination of modulus of rigidity of the material of a rod by static method
4. Determination of rigidity modulus of the material of a wire by dynamic method
5. To determine the moment of inertia of a body about an axis passing

through its center of gravity and to determine the modulus of rigidity of the material of the suspended wire

6. Determination of coefficient of viscosity by Poiseuille's capillary flow method

ES-EE191: Basic Electrical Engineering

Course Code : ES-EE191
Course Title : Basic Electrical Engineering Laboratory
L-T-P :0-0-2
Category **:** Engineering Science Courses
Semester : First
Credit **:**1
Stream **:** B.Tech.
Full Marks : 100(40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Demonstrate the characteristics of carbon, tungsten & florescent lamps.
CO 2	Verify the different electrical parameters obtained using network theorems.
CO 3	Experiment on R-L-C series & parallel circuits

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	2	2	2	1	-	2	2	2	3
CO 2	3	2	2	2	2	2	1	-	2	2	2	3
CO 3	3	2	2	2	2	2	1	-	2	2	2	3

Syllabus (ES-EE191)

Name of the Experiment Performed:

1. First activity: Introduction to basic safety precautions and mentioning of the do's and don'ts. Noting down list of experiments to be performed, and instruction for writing the laboratory reports by the students. Group formation. Students are to be informed about the modalities of evaluation.
2. Introduction and uses of following instruments:

a. Voltmeter
b. Ammeter
c. Multimeter
d. Oscilloscope

Demonstration of real-life resistors, capacitors with color code, inductors and Auto transformer.

3. Demonstration of cut-out sections of machines: DC machine, Induction machine, Synchronous machine and single-phase induction machine.
4. Calibration of ammeter and Wattmeter.
5. Determination of steady state and transient response of R-L, R-C and R-L-C circuit to a step change in voltage.
6. Determination of steady state response of R-L and R-C and R-L-C circuit and calculation of impedance and power factor.
7. Determination of resonance frequency and quality factor of series and parallel R-L-C circuit.
8. A. Open circuit and short circuit test of a single-phase transformer
   B. Load test of the transformer and determination of efficiency and regulation
9. Demonstration of three phase transformer connections. Voltage and current relationship, phase shifts between the primary and secondary side.
10. Measurement of power in a three-phase unbalanced circuit by two wattmeter method.
11. Determination of Torque –Speed characteristics of separately excited DC motor.
12. Determination of Torque speed characteristics and observation of direction reversal by change of phase sequence of connection of Induction motor.
13. Determination of operating characteristics of Synchronous generator.
14. Demonstration of operation of (a) DC-DC converter (b) DC-AC converter (c) DC-AC converter for speed control of an Induction motor
15. Demonstration of components of LT switchgear

ES-ME191: Engineering Graphics & Design

Course Code	: ES-ME191
Course Title	: Engineering Graphics & Design
L-T-P	:1-0-4
Category	**:** Engineering Science Courses
Semester	: First
Credit	**:**3
Stream	**:**B. Tech (AUE)
Full Marks	: 100(40 for Continuous Evaluation;60 for End Semester Exam.)

Course Outcomes

Students will be able to:

CO1	Learn basics of drafting and use of drafting tools which develops the fundamental skills of industrial drawings.
CO2	Know about engineering scales, dimensioning and various geometric curves necessary to understand design of machine elements.
CO3	Understand projection of line, surface and solids to create the knowledge base of orthographic and isometric view of structures and machine
CO4	Become familiar with computer aided drafting useful to share the design model to different section of industries as well as for research &development.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	1	2	1	1	1	-	1	-	-	1
CO2	3	-	2	2	-	1	-	-	1	1	1	1
CO3	2	2	2	1	-	1	1	1	1	-	-	1
CO4	1	-	2	2	2	1	-	-	1	1	1	1

Syllabus (M101)

INTRODUCTION TO ENGINEERING DRAWING
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes

LETTERING, DIMENSIONING, SCALES

Plain scale, Diagonal scale and Vernier Scales.

GEOMETRICAL CONSTRUCTION AND CURVES

Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archemedian Spiral.

PROJECTION OF POINTS, LINES, SURFACES

Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes- Auxiliary Planes.

PROJECTION OF REGULAR SOLIDS

Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).

COMBINATION OF REGULAR SOLIDS, FLOOR PLANS

Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower etc.

ISOMETRICPROJECTIONS

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa Conventions;

SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS

Prism, Cylinder, Pyramid, Cone– Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

OVERVIEW OF COMPUTER GRAPHICS, C**USTOMISATION & CAD DRAWING**

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.

ANNOTATIONS, LAYERING & OTHER FUNCTIONS

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

DEMONSTRATION OF A SIMPLE TEAM DESIGN PROJECT

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modelling software for creating associative models at the component and assembly levels;

floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM)

Books

1. Pradeep Jain, Ankita Maheswari, A. P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
3. Agrawal B.& Agrawal C.M. (2012), Engineering Graphics, MH Publication
4. Shah, M.B.& Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
5. Narayana, K.L.& P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
6. Corresponding set of CAD Software Theory and User Manuals

2ndSemester

BS-CH201: Chemistry-I

Course Code : BS-CH201
Course Title : Chemistry-I
L-T-P : 3-1-0
Category : Basic Science Courses
Semester : 2nd
Credit :4
Stream : B. Tech. (Other than EE and ECE).
Full Marks :100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcomes

Students will be able to:

CO 1	Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces and list major chemical reactions that are used in the synthesis of molecules
CO 2	Rationalize bulk properties using thermodynamic considerations and processes
CO 3	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
CO 4	Rationalise periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	3	2	3	2	1	2	1	1	2	2
CO2	3	3	3	2	3	3	-	1	1	-	-	3
CO3	3	3	3	3	2	2	2	1	2	3	3	1
CO4	3	3	3	3	1	3	1	-	1	-	1	1

Syllabus (BS-CH201)

Unit I: Atomic and molecular structure

Schrodinger equation. Particle in a box solution and their applications for simple sample. Molecular orbitals of diatomic molecules (e.g.H_2). Energy level diagrams of diatomic. molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Unit II: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques. Diffraction and scattering

Unit III: Intermolecular forces and potential energy surfaces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena.

Unit IV: Use of free energy in chemical equilibria

First and second laws of thermodynamics and thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Unit V: Periodic properties

Effective nuclear charge, penetration of orbital's, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

Unit VI: Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical

activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Unit VII: Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Books

Learning Resources

1. Engineering Chemistry, Satyaprakash, Khanna Book Publishing, Delhi
2. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
3. Physical Chemistry, by P. W. Atkins
4. Spectroscopy of Organic Compounds, by P.S.Kalsi, New Age International Pvt Ltd Publishers
5. Physical Chemistry, P. C. Rakshit, Sarat Book House
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition

BS-M202: Mathematics - IIB

Course Code : BS-M202
Course Title : Mathematics - IIB
L-T-P : 3-1-0
Category : Basic Science Courses
Semester : 2nd
Credit : 4
Stream : B. Tech. (AUE).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcomes

CO1	Learn the methods for evaluating multiple integrals and their applications to different physical problems.
CO2	Understand different techniques to solve first and second order ordinary differential equations with its formulation to address the modeling of systems and problems of engineering sciences.
CO3	Learn different tools of differentiation and integration of functions of a complex variable that are used with various other techniques for solving engineering problems.
CO4	Apply different types of transformations between two 2-dimensional planes for analysis of physical or engineering problems.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	3	2	2	2	2	-	-	1	2	2
CO2	3	3	2	2	2	2	-	-	2	-	1	2
CO3	3	3	1	1	2	-	2	-	2	1	-	1
CO4	3	3	2	2	3	2	-	-	-	-	2	2

Syllabus (BS M202)

Module 1: Multivariate Calculus (Integration) [11L]

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, change of variables (Cartesian to Polar), Applications: Areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), Orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Module 2: First order ordinary differential equations [5L]

Exact, linear and Bernoulli's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 3: Ordinary differential equations of higher orders [9L]

Second order linear differential equations with constant coefficients, Use of D - operators, Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Complex Variable – Differentiation [6L]

Differentiation of complex functions, Cauchy-Riemann equations, Analytic functions, Harmonic functions, determination of harmonic conjugate, elementary analytic functions (exponential, their properties.

Module 5: Complex Variable – Integration [9L]

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, Zeros of analytic functions, Singularities, Laurent's series; Residues, Cauchy residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Books

Learning Resources:

1. Reena Garg, Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishers.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3. Michael Greenberg, Advanced Engineering Mathematics, Pearson.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
5. Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.
6. Veerarajan T., Engineering Mathematics for first year, Tata McGraw- Hill, New Delhi.
7. E. L. Ince, Ordinary Differential Equations, Dover Publication.

Course Code: ES-CS201
Category: Engineering Science Courses
Course Title: Programming for Problem Solving
Semester: Second
L-T-P: 3-0-0
Credit: 3

Course Outcomes

CO1	Students will be able to *describe* the meaning of system of numbers, logic gates and the basic anatomy of a computer.
CO2	Students will be able to *understand* the inherent meaning of the basic elements of C Programming Language like; constants, variables, operators, operator precedence etc., and *identify* the use of data types and C statements and *classify* the statements.
CO3	Students will be able to *organize* the statements in appropriate order to *prepare* a complete program that *solves* a specific problem and *analyse* a program to *point out* the bugs that might be present in it and change it to achieve the goal.
CO4	Students will be able to *construct* the final program and *create* the executable module for execution purpose.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	_	_	3	2	1	_	2	3	1	_	2	2
CO2	1	3	2	2	_	2	_	3	2	3	2	2
CO3	3	2	1	2	_	2	3	2	2	2	2	3
CO4	3	2	3	3	2	2	2	1	2	2	3	_

Syllabus (ES-CS 201)

Unit 1: Introduction to Programming (4 lectures)

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - **(1 lecture).**
Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. **(1 lecture)**
From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code- **(2 lectures)**

Unit 2: Arithmetic expressions and precedence (2 lectures)

Unit 3: Conditional Branching and Loops (6 lectures)
Writing and evaluation of conditionals and consequent branching **(3 lectures)**
Iteration and loops **(3 lectures)**

Unit 4: Arrays (6 lectures)
Arrays (1-D, 2-D), Character arrays and Strings

Unit 5: Basic Algorithms (6 lectures)
Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Unit 6: Function (5 lectures)
Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference

Unit 7: Recursion (4 -5 lectures)
Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 8: Structure (4 lectures)
Structures, Defining structures and Array of Structures

Unit 9: Pointers (2 lectures)
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 10: File handling (only if time is available, otherwise should be done as part of the lab)

Books

Learning Resources

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
4. R. S. Salaria, Computer Concepts and Programming in C, Khanna Publishers

HMHU201: ENGLISH

Course Code : HMHU201
Course Title : English
L-T-P : 2-0-0
Category : Humanities and Social Sciences including Management courses
Semester : Second
Credit : 2
Stream : B. Tech. (ALL).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcomes

The students will be able to:

CO 1	Revise the basic grammar of English language.
CO 2	Learn appropriate use of English language to enhance knowledge on building vocabulary and framing sentences
CO 3	Learn and incorporate sensible style in technical writing.
CO 4	Acquire proficiency in English language for comprehensive excellence in reading, listening, writing and speaking.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	1	3	-	2
CO2	-	2	-	1	-	1	-	-	2	3	-	2
CO3	-	2	-	1	-	1	1	2	1	3	-	2
CO4	-	2	-	1	-	1	1	1	2	3	1	2

MODULE I: Vocabulary Building
1.1The concept of Word Formation: Compounding, Backformation, Clipping, Blending. 1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. 1.4 Synonyms, antonyms, and standard abbreviations: Acronyms

MODULE II: Basic Writing Skills
2.1 Sentence Structures & Types: Simple, Compound, Complex 2.2 Use of phrases and clauses in sentences: Transformation of sentences, active, passive, narration2.3 Importance of proper punctuation 2.4 Creating coherence: Arranging paragraphs & Sentences in logical order Creating Cohesion: Organizing principles of paragraphs in documents 2.5 Techniques for writing precisely

MODULE III: Identifying Common Errors in Writing
3.1 Subject-verb agreement 3.2 Noun-pronoun agreement3.3 Misplaced modifiers 3.4 Articles 3.5 Prepositions 3.6 Redundancies3.7 Clichés

MODULE IV: Nature and Style of sensible Writing
4.1 Describing 4.2 Defining 4.3 Classifying 4.4 Providing examples or evidence

MODULE V: Writing introduction and conclusion
5.1 Comprehension 5.2 Précis Writing 5.3 Essay Writing 5.4 Business Letter, Cover Letter & CV; E- mail

Books

Learning Resources:

1. Kulbushan Kumar, R S Salaria, Effective Communication Skills, Khanna Publishing
2. House, Delhi.
3. Practical English Usage. Michael Swan. OUP. 1995.
4. Remedial English Grammar. F.T. Wood. Macmillan.2007
5. On Writing Well. William Zinsser. Harper Resource Book. 2001
6. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
7. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press,
8. 2011.
9. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
10. Universal English Prof. Prasad Kataria Publications, 2019.
11. "Communication Skills for Professionals"-NiraKonar, Prentice Hall of India 2nd edition, NewDelhi,2011.

Department of Automobile Engineering

BS-CH291: Chemistry-I Lab

Course Code : BS-CH291
Course Title : Chemistry-I Laboratory
L-T-P :0-0-3
Category **:** Basic Science Courses
Semester : Second
Credit **:**1.5
Stream **:** B. Tech (AUE).
Full Marks : 100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

The students will be able to:

CO 1	Analyze sample by applying instruments like viscometer, pH-meter, conduct meter, Potentiometer *etc.* to achieve high accuracy.
CO 2	Analyse inorganic salts by semi-micro techniques.
CO 3	Analyze quantitative chemicals present in different samples.

CO-POMapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	2	2	-	3	2	1	1
CO2	1	3	3	3	-	1	2	-	3	2	2	2
CO3	3	3	3	3	3	2	1	1	2	2	2	2

Syllabus

1. Conduct metric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution
2. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution
3. Determination of dissolved oxygen present in a given water sample.

4. To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution)
5. Determination of surface tension and viscosity
6. Thin layer chromatography
7. Ion exchange column for removal of hardness of water
8. Determination of the rate constant of a reaction
9. Determination of cell constant and conductance of solutions
10. Potentiometry-determination of redox potentials and emfs
11. Saponification/acid value of an oil
12. Chemical analysis of a salt
13. Determination of the partition coefficient of a substance between two Immiscible liquids
14. Adsorption of acetic acid by charcoal
15. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatine sols and/or coagulation of the white part of egg

N.B.: **Choose10 experiments from the above15**

Books

1. Advance Practical Chemistry by Subhas C Das, Sarat BookHouse

2. A test book of Macro and Semi micro qualitative Inorganic Analysis by I.Vogel

HMHU291: ENGLISH

Course Code : HMHU291
Course Title : English
L-T-P : 0-0-2
Category **:** Humanities and Social Sciences including Management courses
Semester : Second
Credit **:**1
Stream **:** B. Tech (AUE).
Fullmark's :100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

The students will be able to:

CO1	Get introduced to professional application of English Language with emphasis on listening and speaking skills through language lab aids.
CO2	Practice sessions on pronunciation, intonation, voice modulation, stress, pitch and accent and developing communicative skills with special focus on Group Discussion.
CO3	Master effective reading and writing style through Language Lab aids.
CO4	Ensure proficiency in reading, listening comprehension, technical writing and in speaking.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	1	-	-	-	2	3	-	2
CO2	-	2	-	1	-	1	-	1	3	3	-	2
CO3	-	2	-	1	1	1	1	1	2	3	-	2
CO4	-	2	-	1	1	1	1	1	3	3	-	2

Syllabus (HMHU291)

Honing 'Listening Skill' and its sub skills through Language Lab Audio device; Honing 'Speaking Skill' and it's sub skills

Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/Voice modulation/ Stress/ Intonation/Pitch & Accent) of connected speech

Honing 'Conversation Skill' using Language Lab Audio – Visual input; Conversational Practice Sessions (Face to Face / via Telephone, Mobile phone & Role Play Mode)

Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success; G D Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD

Honing 'Reading Skills' and its sub skills using Visual / Graphics/Diagrams /Chart Display/Technical/Non-Technical Passages Learning Global / Contextual / Inferential Comprehension; 2P8)

Honing 'Writing Skill' and its sub skills by using Language Lab Audio–Visual input; Practice Sessions

ES-ME291: Workshop/Manufacturing

Course Code : ES-ME291
Course Title : Workshop/Manufacturing Practices
L-T-P :1-0-4
Category :Engineering Science Courses
Semester :2nd
Credit :3
Stream :B.Tech.
Fullmark's :100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

The students will be able to:

CO1	Gain basic knowledge of Workshop Practice and Safety useful for our daily living
CO2	Identify Instruments of a pattern shop like Hand Saw, Jack Plain, Chisels etc. and performing operations like such as Marking, Cutting etc. used in manufacturing processes
CO3	Gain knowledge of the various operations in the Fitting Shop using Hack Saw, various files, Scriber, etc. to understand the concept of tolerances applicable in all kind of manufacturing
CO4	Get hands on practice of in Welding and various machining processes which give a lot of confidence to manufacture physical Prototypes in project works.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	2	-	1	3	-	1	1
CO2	2	2	1	1	1	1	1	2	1	1	-	-
CO3	2	-	2	-	-	1	-	1	1	1	1	2
CO4	1	1	1	2	1	3	1	3	2	-	-	1

Syllabus (ES-ME291)

Lectures & videos
Detailed contents

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools
4. Electrical &Electronics
5. Carpentry
6. Plastic moulding, glass cutting
7. Metal casting
8. Welding (arc welding & gas welding), brazing

Workshop Practice:

Machine shop
Typical jobs that may be made in this practice module:

1. To make a pin from a mild steel rod in a lathe.
2. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

Fitting shop
Typical jobs that may be made in this practice module:

1. To make a Gauge from MS plate.

Carpentry
Typical jobs that may be made in this practice module:

1. To make wooden joints and/or a pattern or like.

Welding shop (Arc welding + gas welding)

1. To join two thick (approx. 6mm) MS plates by manual metal arc welding.
2. To join two thin mild steel plates or sheets by gas welding.

Casting
Typical jobs that may be made in this practice module:

1. One/ two green sand moulds to prepare, and a casting be demonstrated.

Smithy

Typical jobs that may be made in this practice module:

1. A simple job of making a square rod from a round bar orlike.

Plastic moulding & Glass cutting
Typical jobs that may be made in this practice module:

1. For plastic moulding, making at least one simple plastic component should be made.
2. For glass cutting, three rectangular glass pieces may be cut to make a kaleidoscope using a black colour diamond cutter, or similar other components may be made.

Electrical & Electronics

1. Familiarization with LT switchgear elements, making its sketches and noting down its specification.

2. Kitkat fuse, Glass cartridge fuse, Plastic fuse holders (optional), Iron clad isolators, MCB style isolators, Single phase MCB, Single-phase wire, wiring cable.

3. Demonstration of domestic wiring involving two MCB, two piano key switches, one incandescent lamp, one LED lamp and plug point.

4. Simple wiring exercise to be executed to understand the basic electrical circuit.

5. Simple soldering exercises to be executed to understand the basic process of soldering.

6. Fabrication of a single-phase full wave rectifier with a step-down transformer using four diodes and electrolytic capacitor and to find its volt-ampere characteristics to understand basic electronic circuit

Books

Learning Resources

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop
Technology”, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. and Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,” Manufacturing Technology – I” Pearson Education, 2008.
4. Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India,1998.

5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

ES-CS291: Programming for Problem Solving

Course Code : ES-CS291
Course Title : Programming for Problem Solving
L-T-P :0-0-4
Category **:** Engineering Science Courses
Semester : 2nd
Credit **:**2
Stream **:** B. Tech.
Full Marks :100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

The students will be able to:

CO 1	Define the specifications like input and output relating to a particular problem and describe the algorithm that solves the problem.
CO 2	Construct each of the modules of a program by restating the steps of the algorithm using functions in the framework of C language.
CO 3	Create the program by using the functions and execute the program.
CO4	Point out the bugs if any, and modify the program to solve the problem.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	-	-	-	-	2	2
CO2	2	2	-	2		2	2	2		1	2	2
CO3	2	2	2	3	1	3	2	3	1	1	3	2
CO4	1	1	-	1	1	2	-	1	1	1	1	2

Syllabus (ES-CS291)

The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.

Tutorial 1: Problem solving using computers:

Lab 1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:

Lab 2. Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:

Lab 4: Iterative problems e.g., sum of series

Tutorial 5:1D Arrays: searching, sorting:

Lab5: 1D Array manipulation

Tutorial6: 2D arrays and Strings

Lab 6: Matrix problems, Stringoperations

Tutorial7: Functions, call by value:

Lab 7: Simple functions

Tutorial8&9: Numerical methods (Root finding, numerical differentiation, numerical integration):

Lab8and9: Programming for solving Numerical methods problems

Tutorial10: Recursion, structure of recursive calls

Lab 10: Recursive functions

Tutorial11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures

Tutorial12: File handling:

Lab 12: File operations

3rd Semester

BS-M301: Mathematics - III (PDE, Probability and Statistics)

Course Code : BS-M301
Course Title : Mathematics - III (PDE, Probability and Statistics)
L-T-P : 3-1-0
Category : Basic Science Courses
Semester : Third
Credit : 4
Stream : B. Tech. (For AUE).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Solve field problems in engineering involving PDEs.
CO 2	Learn the ideas of probability and random variables, calculate probabilities using conditional probability, rule of total probability and Bayes' theorem.
CO 3	Illustrate various discrete and continuous probability distribution with their properties and their applications in physical and engineering environment.
CO 4	Apply statistical tools for analysing data samples and drawing inference on a given data set.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	3	2	1	1	-	-	-	-	-	2
CO2	3	3	2	2	2	2	2	-	2	-	2	2

CO3	3	3	2	2	2	-	1	-	2	-	2	1
CO4	3	3	2	2	3	2	-	-	-	-	2	2

Syllabus (BS-M301)

Module 1: PDE [14L]

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

Module 2: Probability [12L]

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 3: Statistics [12L]

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Books

Learning Resources:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House (AICTE Recommended 2018).

3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003.

5. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

BS BIO-301: Biology

Course Code : BS BIO-301
Course Title : Biology
L-T-P : 2-1-0
Category : Basic Science Courses
Semester : Third
Credit : 3
Stream : B. Tech. (For AUE).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

The learners will be able to:

CO 1	Describe how biological observations of 18th Century that lead to major discoveries. Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
CO 2	Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
CO 3	Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. Classify enzymes and distinguish between different mechanisms of enzyme action.
CO 4	Identify DNA as a genetic material in the molecular basis of information transfer. Analyze biological processes at the reductionist level. Apply thermodynamic principles to biological systems.
CO5	Identify and classify microorganisms.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	2	1	2	-	2	-	-	1	-	-	2
CO2	2	2	2	2	-	3	-	-	1	-	-	3
CO3	1	3	1	3	-	2	-	-	2	-	-	2
CO4	2	2	1	3	-	3	-	-	1	-	-	3
CO5	1	2	2	2	-	2	-	-	2	-	-	2

Syllabus

Unit I:Introduction to biology

To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Unit II: Classification

The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Unit III: Genetics

To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Unit IV: Bio-molecules

To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Unit V: Enzymes

To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Unit VI: Information transfer

The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Unit VII: Macromolecular analysis

How to analyze biological processes at the reductionist level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Unit VIII: Metabolism

The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keqand its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Unit IX: Microbiology

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Books

Learning Resources:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd

2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons

3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company

4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman andcompany, Distributed by Satish Kumar Jain for CBS Publisher

5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. BrownPublishers

6. Biology for Engineers, McGraw Hill (ISBN: 978-11-21439-931)

Department of Automobile Engineering

ES-ECE-301: Basic Electronics Engineering

Course Code : ES-ECE-301
Course Title : Basic Electronics Engineering
L-T-P : 3-0-0
Category : Engineering Science Courses
Semester : Third
Credit : 3
Stream : B. Tech
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

The learners will be able to:

CO 1	Understand the basic electronic devices (Diode, BJT, etc) and applications.
CO 2	Comprehend the operation of OpAmp and Oscillators.
CO 3	Design basic digital electronic circuits.
CO 4	Realize the functioning of electronic communication system

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	1	1	1	-	3	2	1	-	3
CO2	2	2	3	2	-	-	1	3	2	2	1	2
CO3	3	3	2	2	1	1	1	2	2	1	2	3
CO4	2	2	2	1	1	-	1	3	2	2	1	2

Syllabus

Semiconductor Devices and Applications

Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth

Operational amplifier and its applications

Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical opamp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

Timing Circuits and Oscillators

RC-timing circuits, IC 555 and its applications as a stable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

Digital Electronics Fundamentals

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, de- multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Electronic Communication Systems

The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Books

Learning Resources:

1. Floyd, “Electronic Devices”, Pearson Education 9th edition, 2012.

2. R.P. Jain, “Modern Digital Electronics”, Tata Mc Graw Hill, 3rd Edition, 2007.

3. Frenzel, “Communication Electronics: Principles and Applications”, Tata Mc Graw Hill, 3rd Edition, 2001.

4. R. Anand, “Digital Electronics”, Khanna Publishing House, New Delhi, 2017.

Department of Automobile Engineering

ES-AUE301: Engineering Mechanics

Subject Code : ES-AUE301
Category : Engineering Science Courses
Subject Name : Engineering Mechanics
Semester : Third
L-T-P :3-1-0
Credit : 4
Stream : B. Tech
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Understand scalar and vector analytical techniques for analyzing forces in practically used statically determinate structures.
CO2	Apply basic kinematics & dynamics concepts, Newton's Law of Motion, Work-Energy principle and Impulse Momentum principle to solve Kinematics and Dynamics problems.
CO3	Analyze all the concepts of linear kinetics to systems in general plane motion (Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces).
CO4	Evaluate the fundamental concepts of kinematics and kinetics of particles while designing simple and basic machine parts.
CO5	Create and develop some fundamental models, projects related to basic machine parts such as pulleys and mass spring systems.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	1	1	1	1	-	-	-	3
CO2	3	3	3	3	2	-	-	-	-	-	-	2
CO3	3	3	3	3	1	-	-	-	-	-	-	3
CO4	3	3	3	3	2	2	1	2	2	2	2	3
CO5	3	3	3	3	1	2	2	1	2	2	2	3

Syllabus

Module 1: Introduction to Engineering Mechanics

Force Systems: Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.

Module 2: Friction

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Module 3: Basic Structural Analysis

Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

Module 4: Centroid and Centre of Gravity

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Module 5: Virtual Work and Energy Method

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Module 6: Review of particle dynamics

Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

Module 7:Introduction to Kinetics of Rigid Bodies

Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

Module 8: Mechanical Vibrations

Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulums, use of simple, compound and torsion pendulums;

Tutorials from the above modules covering, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack

Books

1. D.S. Bedi, Engineering Mechanics, Revised Edition, Khanna Publishing House, New Delhi, 2018.
2. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
3. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
4. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
5. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
6. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
7. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education
8. Reddy Vijaykumar K. and K. Suresh Kumar (2010), Singer's Engineering Mechanics
9. Bansal R.K. (2010), A Text Book of Engineering Mechanics, Laxmi Publications
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

Department of Automobile Engineering

PC-AUE301: Engineering Mechanics

Subject Code : PC -AUE301
Category : Professional Core Courses
Subject Name : Applied Thermodynamics
Semester : Third
L-T-P :3-1-0
Credit : 4
Stream : B. Tech
Full Marks :100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Understand the basic laws of thermodynamics and mutual relationships between energy, work, heat, internal energy enthalpy entropy used in different practical energy transferring systems.
CO2	Apply the concepts of pure substances and phase diagrams for analyzing the phase change processes of conventionally used working fluids in industries.
CO3	Analyze the different thermodynamic property relations for equilibrium conditions, spontaneity and stability of a thermodynamic process.
CO4	Evaluate the different properties of steam, methodologies of generation of electricity through steam in boilers, steam condensers and turbines.
CO5	Evaluate the different properties of air and refrigerants & their nature of applications to realize the principle of working of refrigeration and air conditioning.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	-	2	2	1	-	-	-	3
CO2	3	3	3	3	2	2	2	2	-	-	-	2
CO3	3	3	3	3	-	-	-	-	-	-	-	3
CO4	3	3	3	3	2	1	2	-	2	2	2	3
CO5	3	3	3	3	2	1	2	-	2	2	2	3

Syllabus

Module 1: Basic Concepts

Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasistatic process, work, modes of work. Zeroth law of thermodynamics, concept of temperature and heat. Concept of ideal and real gases.

Module 2: First Law of Thermodynamics

Concepts of Internal Energy, Specific Heat Capacities, Enthalpy. Energy Balance for Closed and Open Systems, Energy Balance for Steady-Flow Systems. Steady-Flow Engineering Devices. Energy Balance for Unsteady- Flow.

Module 3: Second Law of Thermodynamics

Thermal energy reservoirs, heat engines energy conversion, Kelvin's and Clausius statements of second law, the Carnot cycle, the Carnot Theorem, the thermodynamic temperature scale, the Carnot heat engine, efficiency, the Carnot refrigerator and heat pump, COP. Clausius inequality, concept of entropy, principle of increase of entropy – availability, the increase of entropy principle, perpetual-motion machines, reversible and irreversible processes, Entropy change of pure substances, isentropic processes, property diagrams involving entropy, entropy change of liquids and solids, the entropy change of ideal gases, reversible steady flow work, minimizing the compressor work, isentropic efficiencies of steady-flow devices, and entropy balance. Energy - a measure of work potential, including work potential of energy, reversible work and irreversibility, second-law efficiency, exergy change of a system, energy transfer by heat, work, and mass, the decrease of exergy principle and exergy destruction, energy balance: closed systems and control volumes energy balance.

Module 4: Properties of Pure Substance

Properties of pure substances. Thermodynamic properties of pure substances in solid, liquid and vapour phases. Phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces. Thermodynamic properties of steam. Calculations of work done and heat transfer in non- flow and flow processes.

Module 5: Power Cycles

Vapour and combined power cycles, including the Carnot vapor cycle, Rankine cycle: the ideal cycle for vapor power, the ideal reheat and regenerative and the second-law analysis of vapour power cycles. Gas power cycles, including basic considerations in the analysis of power cycles, the Carnot cycle and its value in engineering, an overview of reciprocating engines, air standard assumptions, gasoline engine Otto cycle, diesel engine cycle, gas-turbine Brayton cycle, and the second-law analysis of gas power cycles.

Module 6: Ideal and Real Gases and Thermodynamic Relations

Gas mixtures – properties ideal and real gases. Equation of state, Avogadro's Law, Vander Waal's equation of state, Compressibility factor, compressibility chart. Dalton's law of partial pressure. Exact differentials, T-D relations, Maxwell's relations. Clausius Clapeyron equations, Joule – Thomson coefficient.

Module 7: Psychometry and psychometric charts

Property calculations of air vapour mixtures. Psychometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling. Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables. Refrigeration cycles, including refrigerators and heat pumps, the ideal reversed Carnot vapour compression refrigeration cycle, actual vapor compression refrigeration cycles, heat pump systems, gas refrigeration cycles, and absorption refrigeration systems.

Books

Learning Resources

1. Nag. P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi.

2. Cengel, Thermodynamics – An Engineering Approach, Tata McGraw Hill, New Delhi.

3. Sonntag, R. E., Borgnakke, C., & Wylen, G. J. V. Fundamentals of thermodynamics: Wiley.

4. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. Fundamentals of Engineering Thermodynamics: John Wiley & Sons.

5. Jones, J. B., & Dugan, R. E. Engineering thermodynamics: Prentice Hall.

6. Potter, M. C., & Somerton, C. W. Schaum's Outline of Thermodynamics for Engineers, McGraw-Hill.

PC-AUE 302: Manufacturing Methods

Subject Code : PC-AUE302
Category : Professional Core courses
Subject Name : Manufacturing Methods
Semester : Third
L-T-P : 4-0-0
Credit : 4
Stream : B. Tech (AUE)
Full Marks :100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Students will be able to understand the concepts of conventional manufacturing processes i.e., Casting, Forging and Welding.
CO2	Students will be able to apply the principles of the conventional manufacturing processes to design cost effective and sustainable manufacturing techniques for different materials.
CO3	Students will be able to analyze the several manufacturing defects and its remedies to overcome the same.
CO4	Students will be able to identify the specific manufacturing processes applied in Industries for manufacturing several materials.

CO-PO Mapping

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO 1	3	3	3	2	2	-	-	-	-	-	-	3
CO 2	3	3	3	2	2	3	3	2	2	2	3	3
CO 3	3	3	3	3	3	-	-	-	-	-	-	3
CO 4	3	3	3	3	3	3	2	2	2	2	3	3

Syllabus

Conventional Manufacturing Processes

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending).

Tool geometry and single point cutting tools, orthogonal and oblique cutting, rake, cutting tool signature; Chip shape and chip formation, chip tool interface, chip flow, built up edge, machined surface. Forces during turning, Merchant's circle diagram for cutting forces, force systems at chip tool interface and shear plane, velocity relationships and problems. Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Joining/fastening processes: Physics of welding, types of welding, brazing and soldering; Solid and liquid state joining processes.

Unconventional Machining Processes

Abrasive Jet Machining, Ultrasonic Machining, principles and process parameters, Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM).

Books

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014

2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley Publication.

3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing, Wiley Publication.

PC-AUE 391: Machine Drawing

Subject Code : PC-AUE391
Category : Professional Core Courses
Subject Name : Machine Drawing
Semester : Fourth
L-T-P : 0-0-3
Credit :1.5
Stream : B. Tech (AUE)
Full Marks : 100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Understand conventional representation of common machine elements such as screws, nuts, bolts, keys, gears, webs, ribs and the product symbols of welding joints, pipe joints etc.
CO2	Visualize and able to draw orthographic projections of machine elements as well as auxiliary sectional views.
CO3	Preparation of assembly drawings with dimensions and part drawing of various machine components like stuffing box, flange coupling, universal joint etc.
CO4	Recognize the various tools of AutoCAD software and using the commands create orthographic and isometric views.

CO-PO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	1	2	-	-	-	-	-	-	3
CO 2	3	3	3	2	1	3	3	2	2	2	3	3
CO 3	3	3	2	1	3	-	-	-	-	-	-	3
CO 4	3	3	2	1	3	1	1	2	2	2	1	3

Syllabus

Schematic product symbols for standard components in mechanical, electrical and electronic systems, welding symbols and pipe joints; Orthographic projections of machine elements, different sectional views- full, auxiliary sections; Isometric projection of components; Assembly and detailed drawings of a mechanical assembly, such as a Plummer block, tool head of a shaping machine, tailstock of a lathe, simple gear box, flange coupling, welded bracket joined by stud bolt on to a structure, welded pipe joints indicating work parts before welding, etc.

Practicing AutoCAD or similar graphics software and making orthographic and isometric projections of different components.

Books

Learning Resources

1. Dhawan, R.K., A Text Book of Machine Drawing, S. Chand & Company, 1996.
2. K.L. Narayana, P. Kannaiah, K. VenketaReddy , New Age International Publishers
3. Sham &Tikku MASTERING AUTOCAD 2011, Dreamtech Press
4. P.S. Gill, Textbook of Machine Drawing, Katson Books

4th Semester

ES-AUE 401: Materials Engineering

Subject Code : ES-AUE401
Category : Engineering Science Courses
Subject Name : Materials Engineering
Semester : Fourth
L-T-P : 3-0-0
Credit :3
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Understand the crystal structures, defects leading to the different material properties suitably chosen for Industrial Purposes.
CO2	Apply the concepts of plastic and elastic deformations to specifically choose the materials when applied under external loading conditions.
CO3	Analyze the Iron Carbon Diagram to predict the changes in the material characteristics during different Heat Treatment processes applied for the industrial purposes.
CO4	Evaluate the properties, characteristics and uniqueness of various Ceramics, Composites and Refractory Materials.
CO5	Predict and develop visual charts for the different materials (depending on their properties and other characteristics) which are used during designing different Automotive Components.

CO-PO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1	3	3	3	1	1	1	1	-	-	-	-	3
CO 2	3	3	3	1	-	-	-	-	-	-	-	3
CO 3	3	3	2	1	3	-	-	-	-	-	-	3

CO 4	3	3	2	1	3	-	-	-	-	-	-	3
CO 5	3	2	2	2	2	1	1	2	1	2	1	2

Syllabus

Crystal Structure

Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Mechanical Property measurement

Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Mechanisms of Plastic and Elastic deformations

Slip and Twinning, Recover Recrystallization and Grain growth- Strengthening Mechanism- Strain hardening, Precipitation hardening, Refinement of Grain, solid solution strengthening, Types of Fracture-, Ductile and Brittle fracture- Griffith's theory, Creep - Mechanisms of Creep- Creep resistant materials, Fatigue Failure- SN curve- Factors affecting fatigue life, prevention of fatigue failure.

Alloys, substitutional and interstitial solid solutions

Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Heat treatment of Steel

Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

Alloying of steel, properties of stainless steel and tool steels, maraging steels

Cast irons. Advance materials for automotive components: Characteristics, advantage/ disadvantages, and applications. Ceramic Materials: What are ceramics; common ceramic materials and their characteristics; How ceramics are

made—sintering and vitrification process; Ceramic structures; Properties and applications.

Composite materials

What are composites; Polymers matrix and their applications; Metal matrix and ceramic matrix composites and their applications; How composites are made.

Criteria for selecting materials for automotive components

Cylinder Block, Cylinder Head, Piston, Piston Ring, Gudgeon pin, Connecting Rod, Crank Shaft, Cam Shaft, Cam, Engine Valve, Gear, Crown wheel and pinion, Clutch plate, Axle shaft, Chassis, spring, body panel, Brake lining etc.

Books

Learning Resources

1. W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India.

2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.

3. V. Raghavan, “Material Science and Engineering’, Prentice Hall of India Private Limited, 1999.

4. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.

PC-AUE 401: Strength of Materials

Subject Code : PC-AUE401
Category : Professional Core Courses
Subject Name : Strength of Materials
Semester : Fourth
L-T-P : 3-1-0
Credit :4
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Describe fundamental properties of engineering materials, fundamental concepts of all types of stress, strain & moments and its application in various members.
CO2	Evaluate various methods of finding principal plane and deflections in members; which are generally applied in real life designs.
CO3	Analyze strain energy, torsion and elastic stability applicable for various mechanical and structural members.
CO4	Design various members subjected to external load considering the deformations and deflections.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	-	-	-	2	1	-	-	-	-	2
CO 2	3	3	2	1	2	2	1	1	1	-	1	2
CO 3	3	3	2	1	2	2	2	2	1	-	1	3
CO 4	3	3	3	3	3	3	2	2	2	3	3	2

Syllabus

Deformation in solids - Hooke's law, stress and strain- tension, compression and shear stresses – elastic constants and their relations- volumetric, linear and shear strains - principal stresses and principal planes - Mohr's circle.

Beams and types of transverse loading on beams- shear force and bend moment diagrams - Types of beams supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems. Buckling of columns, Euler's theory, critical loads for different types of constraints.

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

Books

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.

2. D.S. Bedi, Strength of Materials, Khanna Publishing House, 2018.

3. R. Subramanian, Strength of Materials, Oxford University Press, 2007.

4. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.

5. Debabrata Nag and Abhijit Chanda, Fundamentals of Strength of Materials, Wiley India.

PC-AUE 402: Fluid Mechanics & Hydraulic Machines

Subject Code : PC-AUE402
Category : Professional Core courses
Subject Name : Fluid Mechanics & Hydraulic Machines
Semester : Fourth
L-T-P : 4-0-0
Credit :4
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Define fundamental concepts of fluid mechanics.
CO2	Derive the equations for finding out the various factors involved in fluid flow field.
CO3	Calculate the various element required for designing a component/ machine part/civil construction under the presence of fluid
CO4	Analyze momentum, dimensional & model investigation applied in flow field.
CO5	Evaluate the performance of hydraulic machines.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	-	1	1	-	-	-	-	2
CO 2	3	1	-	-	-	-	1	-	-	-	1	1
CO 3	3	2	2	2	3	2	-	-	2	1	-	2
CO 4	3	3	3	3	2	-	2	1	2	2	3	3
CO 5	3	3	2	2	2	2	1	2	2	2	2	3

Syllabus

Module 1: Definition of fluid, Newton's law of viscosity, Units and dimensions - Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.

Module 2: Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram.

Module 3: Need for dimensional analysis–methods of dimension analysis–Similitude–types of similitude. Dimensionless parameters–application of dimensionless parameters–Model analysis.

Module 4: Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps - Reciprocating pump – working principle.

Module 5: Impact of Jet, Classification of water turbines, heads and efficiencies, velocity triangles - Axial, radial and mixed flow turbines - Pelton wheel, Franci's turbine and Kaplan turbines, working principles – draft tube - Specific speed, unit quantities, performance curves for turbines – governing of turbines.

Books

1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House.

2. Fluid Mechanics and Machinery, R.K.Bansal, Laxmi Publication.

3. Introduction to Fluid Mechanics & Fluid Machines, Som and Biswas, TMH.

4. A Textbook on Fluid Mechanics and Machines, S.Pati, McGrawHill.

5. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010.

6. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House.

7. Fluid Machinery, Sadhu Singh, Khanna Publishing House, 2017.

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PC-AUE 403: Theory of Machines

Subject Code : PC-AUE403
Category : Professional Core Courses
Subject Name : Theory of Machine
Semester : Fourth
L-T-P : 3-1-0
Credit :4
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to

CO 1	Understand the concept of commonly used mechanism for industrial application.
CO 2	Analyze the velocity and acceleration of a mechanisms analytically and synthesis of problems.
CO 3	Draw the various cam profile diagram with respect to different followers used in various industrial applications.
CO 4	Evaluate the belt drive system and gear mechanisms for a given motion or a given input/output motion or force relationship.
CO 5	Create the different models by using the different mechanisms to solve the various societal and environmental problems.

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	2	-	-	-	-	2	-	2
CO 2	3	3	2	2	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	2	-	1	1	1	-	-
CO 5	3	3	3	3	3	2	3	3	3	2	2	-

Syllabus

Classification of mechanisms
Basic kinematic concepts and definitions-Degree of freedom, mobility - Grashof's law, Gruebler's criterion for plane mechanism, Kinematic inversions of four bar chain and slider crank chains- Limit positions - Mechanical advantage Transmission angle- Description of some common mechanisms-Quick return mechanism, straight line generators (pantograph) -Universal Joint-Rocker mechanisms.

Displacement, velocity and acceleration analysis
Simple mechanisms, graphical velocity analysis using instantaneous centres, velocity and acceleration analysis using loop closure equations kinematic analysis of simple mechanisms - slider crank mechanism dynamics-Coincident points - Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation.

Classification of cams and followers
Terminology and definitions-Displacement diagrams – Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller, flat face and knife edge followers.

Gear and Gear Trains
Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/ undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

Belt-drive
Introduction; Law of belting, Length of flat belt for open and cross belt connections; Stepped pulley for open flat belt; Tension in flat belt and V-belts; Power transmitted in belt drive.

Books

Learning Resources

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. Cleghorn W.L., Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi 1988.

Department of Automobile Engineering

PC-AUE 404: Metrology & Instrumentation

Subject Code: PC-AUE404
Category: Professional Core courses
Subject Name: Metrology & Instrumentation
Semester: Fourth
L-T-P: 3-0-0
Credit: 3
Stream: B. Tech (AUE)
Full Marks: 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to

CO 1	Understand the fundamentals of scientific measurements, standards, inspection methodologies and errors induced.
CO 2	Apply the concepts of Limits, Limit Gauges, Fits and Tolerances for measurement of Industrial Components or the components needed for their individual projects.
CO 3	Analyze the various instruments to measure angles, threads, gears and surface finish.
CO 4	Evaluate the digital measurement devices (Sensors, Transducers) to measure force and torque; strain and stress and temperature.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	2	1	-	-	-	-	-	3
CO 2	3	3	2	2	3	2	1	2	2	2	2	3
CO 3	3	3	-	-	-	-	-	-	-	-	-	3
CO 4	3	3	2	2	2	2	-	1	1	1	-	2

Syllabus

Module 1: Concept of measurement

Introduction to Metrology; Need for high precision measurements; Terminologies in Measurement- Precision, accuracy, sensitivity, calibration, resolution. Errors in Measurement, types of errors, Abbe's Principle. Basic standards of length- Line standard, End standards, Wavelength standard; Various Shop floor standards. Linear Measurement – Slip gauges, wringing, grades; Surface plate; Dial indicators; Height gauges and Vernier calliper; screw gauge. Comparators- mechanical, electrical, optical and pneumatic. Angular Measurement – Bevel protractor; Sine Bar, principle and use of sine bar, sine centre; Angle gauges. Sprit level; Angle Dekkor; Clinometers.

Module 2: Limits and Limit gauges

Making to suit, selective assembly, systems of limits and fits; Types of fits; Hole basis system and Shaft basis system. Tolerance, allowance and deviation (as per BIS). Limit Gauges – GO and NO GO gauges; types of limit gauges. Gauge design - Taylor's principle of gauging; Gauge tolerance, disposition of gauge tolerance, wear allowance. Optical Measuring Instruments: - Benefits of light waves as standards; Monochromatic light; Principle of Interference. Interference band, optical flat, surface measurement. Interferometers – NPL, Pitter-NPL, auto collimator.

Module 3: Screw thread measurement

Screw thread terminology; Measurement of major diameter; root diameter; pitch; effective diameter with two wire method and three wire method. Measurement of flank angle and form by profile projector and microscope. Measurement of surface texture – roughness and waviness; Analysis of surface traces, peak to valley height, R.M.S. value, Centre Line Average and R_a value, R_t, R_z etc. Methods of measuring surface roughness – Stylus probe, Tomlinson surface meter, Talysurf; surface roughness measurement – assessment length, roughness width cut-off, sampling length and evaluation length.

Module 4: Introduction to Digital Measurement

Significance of Digital measurement; methods; Classification. Stages in generalized measuring system – Sensor-Transducer stage, Signal-Conditioning stage, Readout Recording stage; Types of input quantities; Active and Passive transducers. Performance characteristic of measuring devices. Drift, Resolution, Threshold, Hysteresis, Static calibration. Dynamic characteristics different order systems and their response-, Measuring lag, Fidelity, Dynamic error; Transducers – Working, Classification of transducers. Motion and Dimension measurement – LVDT – Principle, applications, advantages and limitations.

Module 5: Strain and Stress Measurement

Electrical resistance strain gauge - Principle, operation. Measurement of Force and

Torque – Strain-Gauge Load Cells, Hydraulic and Pneumatic load cells – force measurement using piezoelectric quartz crystal. Torque Measurement – Dynamometers – Mechanical, Hydraulic and Electrical. Vibration measurement – Vibrometers and Accelerometers. Temperature Measurement – Use of Thermal Expansion – Liquid-in-glass thermometers, Bimetallic strip thermometer, Pressure thermometers. Thermocouples – Resistance Temperature Detectors (RTD); Thermistors; Pyrometers.

Books

Learning Resources

1. Anand K Bewoor, Vinay A Kulkarni, Metrology & Measurement, McGraw-Hill, 2009

2. Ernest O. Doebelin, Dhanesh N. Manik, Measurement Systems Application and Design, McGraw-Hill, 2004

3. Galyer J.F.W., Schotbolt C.R., Metrology for Engineers, ELBS,1990

4. Thomas G. Beckwith, John H. L., Roy D. M., Mechanical Measurements, 6/E, Pearson Prentice Hall, 2007

5. R.K. Rajput, Mechanical Measurements & Instrumentation, S.K.Kataria& Sons.

PC-AUE 491: Manufacturing and Testing Lab

Subject Code: PC-AUE491
Category: Professional Core courses
Subject Name: Manufacturing and Testing Lab
Semester: Fourth
L-T-P: 0-0-3
Credit: 1.5
Stream: B. Tech (AUE)
Full Marks: 100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

Students will be able to

CO 1	To understand the mechanical properties of isotropic materials in different loading conditions by Tension, Compression, Impact, Hardness and Fatigue Tests.
CO 2	To analyze the different microstructural, metallurgical and mechanical properties of materials by different heat treatment techniques.
CO 3	To evaluate the various methods and types of molding sands, patterns and castings used in industrial products development.
CO 4	To design and define the basic forging processes to manufacture typical industrial products like sheet metal or Automotive Components.
CO 5	To fabricate weld joints using gas welding and arc welding and thereafter inspect the quality of welded joints using non-destructive testing methods.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	2	2	2	1	2	2	1	3
CO 2	3	3	2	2	3	2	-	1	2	2	1	3
CO 3	3	3	2	2	2	1	1	1	2	2	1	3
CO 4	3	3	2	2	2	2	-	1	2	2	1	2
CO 5	3	3	2	2	2	2	2	1	2	2	1	2

Syllabus

About 12 experiments will be carried out as listed below.

1. Impact tests: Charpy or Izod tests; Hardness test, Test for drawability of sheet metals through cupping test.

2. Fatigue test of a typical sample.

3. Sample preparation and etching of ferrous and non-ferrous metals and alloys for metallographic observation.

4. Experiments on heat treatment of carbon steels under different rates of cooling including quenching, and testing for the change in hardness, and observing its microstructural changes for standard specimen through metallographic studies.

5. Determining spring stiffness under tension and compressive loads; Strain gauge-based strain/ deflection/ force measurement of a cantilever beam.

6. Tension Test and Compression Test of ductile and brittle materials: stress-strain diagram, determination of yield strength, ultimate strength, modulus of elasticity, percentage elongation and percentage reduction in areas, observation of fractured surfaces; Bend and re-bend test of flat test pieces, determination of bending stresses.

7. Torsion Test; Experiments on friction: determination of coefficient of friction

8. Sand preparation and testing: specimen preparation for testing permeability, clay content, grain fineness number, moisture content, green compression strength, green shear strength, splitting strength, hardness, etc.

9. Casting of metals after preparation of a suitable type moulds; Experiments on properties of post casting, fettling, cleaning, deburring, and polishing operations; Same experiment for another type of moulds.

10. Practicing smithy or forging of carbon steels and testing for its property changes

11. Laboratory experiments in Fabrication processes to observe effects of varying process parameters in GMAW

12. Testing for Joint defects in GMAW with visual inspection and DP test.

13. Surface roughness measurement.

14. Measurement of threads, gears.

Books

1. Materials Science and Engineering by W.D. Callister and adapted by R. Balasubramanian, Willey India, 2010 Ed.

2. Engineering Materials: properties and selection by Budinski & Budinski, 9th Ed., Prentice Hall India

3. Engineering Materials and Metallurgy by R. Srinivasan, 2nd Ed., Tata McGraw Hill.

4. Materials & Processes in Manufacturing by E.P.Degarmo and adapted by Black & Kosher, 10th Ed., Wiley India.

5. Materials Science and Engineering by V.Raghavan, 5th Ed., Prentice Hall India.

6. Manufacturing technology, Foundry, Forming & Welding-P.N Rao.

7. Manufacturing Science-A Ghosh & A Mullick.

8. Manufacturing Engineering & Technology-S Kalpakjian; Pub:Addison Wesley.

9. Principles of manufacturing materials & processes-James & Campbell

Department of Automobile Engineering

MC 481: Environmental Science

Course Name : Environmental Sciences
Course Code : MC-481
Course Title : Environmental Sciences
L-T-P : 0-0-2
Category : Basic Science Courses
Semester : 4th
Credit : 0
Stream : B. Tech. (AUE)
Full Marks : 100 (Sessional Paper)

Course Outcome (CO)

The learners will be able to:

CO 1	To understand the natural environment and its relationships with human activities
CO 2	To apply the fundamental knowledge of science and engineering to assess environmental and health risk
CO 3	To develop guidelines and procedures for health and safety issues obeying the environmental laws and regulations
CO 4	Acquire skills for scientific problem-solving related to air, water, noise& land pollution

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	3	2	3	2	3	3	1	1	2	2
CO2	3	3	2	2	3	3	3	2	1	-	2	3
CO3	2	2	3	3	2	2	3	3	2	3	3	3
CO4	3	2	3	3	1	3	3	3	1	-	2	2

Syllabus

The **syllabus** covers the following activities and topics

Awareness Activities

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii) Slogan making event
iii) Poster making event
iv) Cycle rally
v) Lectures from experts

Actual Activities

i) Plantation
ii) Gifting a tree to see its full growth
iii) Cleanliness drive
iv) Drive for segregation of waste
v) To live some big environmentalist for a week or so to understand his work
vi) To work in kitchen garden for mess
vii) To know about the different varieties of plants
viii) Shutting down the fans and ACs of the campus for an hour or so

Books

Learning Resources

1. M.P. Poonia & S.C. Sharma, Environmental Studies, Khanna Publishing House, New Delhi, 2019

2. P.K. Bose, Environment Ecology and Sustainable Management, Everest Publishing House

Department of Automobile Engineering

5th Semester

PC – AUE 501: Automotive Engines

Subject Code : PC – AUE 501
Category : Professional Core Courses
Subject Name : Automotive Engines
Semester : Fifth
L-T-P : 3-0-0
Credit : 3
Stream: B. Tech (AUE)
Full Marks: 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to

CO 1	Understand various air standard cycles of operations of Internal combustion engines, concept of knocking and fuel ignition system in various engines and the working of lubrication and cooling system in Internal Combustion Engine.
CO 2	Evaluate the Engine performance under different parameters of Internal Combustion Engine
CO 3	Analyze the current scenario on the pollution caused by the emission of different noxious gases emitted from Engine Exhaust.
CO 4	Illustrate various methods applied on the Internal Combustion Engine by the different Industries to control the emission.
CO 5	Create the various emission control technologies which can be used in IC engine to reduce the emission level of various noxious gases emitted from the engine exhaust.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	-	-	2	-	-	-	-	-	-	-
CO3	3	3	-	3	-	3	3	-	-	1	-	-
CO4	3	2	-	2	-	2	3	-	-	2	-	-
CO 5	3	2	2	2	3	2	3	2	2	3	2	

Syllabus

Introduction

Basic air standard cycle Otto, Diesel & dual fuel cycle, comparison between Otto, Diesel and Dual fuel cycles. Basic Concepts-Air standard cycles and fuel-air cycles Assumptions Valve Timing diagram, Actual engine cycle.

Engine Construction

Construction and working of 4 stroke SI and CI Engine, Comparison between SI and CI engine, SI and CI engine fuel rating, octane number and cetane number, SI and CI Engine fuel properties, Alternative fuels (Alcohol, Biogas, Hydrogen, CNG, LPG).

SI Engine

Theory of Carburetion, Types of carburettors, Electronic fuel injection system, GDI. Combustion in spark Ignition engines, stages of combustion, flame propagation, rate of pressure rise, abnormal combustion. Phenomenon of Detonation in SI engines, effect of engine variables on Detonation, Combustion Chambers, Rating of fuels in SI engines and additives.

CI Engine

Fuel supply system, types of fuel pump, injector and distribution system, Combustion in compression ignition engines, stages of combustion, factors affecting combustion, Phenomenon of knocking in CI engine, Effect of knocking, Types of combustion chambers rating of fuels in CI engines. Additives Comparison of knocking in SI & CI engines, Concepts of Supercharging and Turbo charging.

Engine systems and components

Ignition system. (Battery, magneto & electronic); Lubrication system; Engine starting system; Engine cooling system; Governing system (quality and quantity hit & miss

governing); Intake and exhaust systems (two valves & four valves); Drive train (cam shaft, valves etc.).

Fuels and Emissions

Chemical structure of the Petroleum, Refining process for petroleum, important qualities of the Engine fuels- (SI & CI engines), Diesel, and Gasoline fuels, Indian specifications. Alternate fuels (SI & CI engines) - Liquid fuels, gaseous fuels (LPG, NG, CNG), hydrogen and emulsified fuel. Air pollution due to IC engine, Engine emissions, Hydrocarbon emissions, (HC) & PM & Carbon monoxide emissions (CO), oxides of Nitrogen (NOx) Euro norms, Bharat stage norms, Introduction to EDC and IDC, Introduction to carbon credit, Emission control methods for SI and CI engines, Electronic control module, Catalytic converters, EGR Concept of hybrid vehicles.

Cooling and Lubrication system

Need for cooling system. Types of cooling system, Liquid cooled system, Thermosyphon system, and pressure cooling system. Lubrication system - Mist lubrication system, wet sump and dry sump lubrication, properties of lubricants, Properties of coolants.

Performance characteristics & Testing of I.C. Engines

Introduction to Indian. Standards for testing of I.C. Engine, mean effective pressure, indicated power, brake power, friction power, Methods to determine power and efficiencies Variables affecting performance of engine, characteristic curves, heat balance sheet, Methods of improving engine performance; super & turbocharged engines.

Books

Learning Resources

1. Ganesan V., Internal Combustion Engines, Tata McGraw Hill Co., Third Edition, 2007.
2. Obert E.F., Internal Combustion Engines and Air Pollution, Harper and Row Publication Inc. New York, 1973.
3. Heisler H., Advanced Engine Technology, Edward Arnold, 1995.
4. Heywood J.B., Internal Combustion Engine Fundamentals, McGraw Hill Book Co., New York, 1989.
5. Heldt P.M., High Speed Combustion Engines, Oxford & IBH publishing Co., India, 1985.
6. Stockel M.W., Stockel T.S. and Johanson C., Auto Fundamentals, The Goodheart, Wilcox Co. Inc., Illinois, 19

PC – AUE 502: Automotive Body & Chassis Engineering

Subject Code : PC-AUE 502
Category : Professional Core Courses
Subject Name : Automotive Body & Chassis Engineering
Semester : Fifth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (AUE)
Full Marks :100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students Will be able to:

CO1	Understand the various types of vehicle chassis layout and its application characteristics.
CO2	Implement the constructional features, working principles and functions of various automotive systems such as Axles, Steering Systems, Drive Lines, Suspension Systems, Braking Systems to conceptualise new Automotive Systems.
CO3	Analyse the different types of wheels & tyres and their specifications, their defects.
CO4	Assess the various things related to driver's comfort level, visibility zone, safety purposes as well as passengers, vehicle aerodynamics.
CO5	Identify the different types of vehicle body materials, parts repairing and use of vehicle paintings.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	-	-	2	2	1	-	-	2	2
CO 2	3	2	2	2	2	-	-	-	-	-	3	2
CO 3	3	2	-	2	3	-	2	-	2	1	2	2
CO 4	3	3	2	3	2	2	-	2	2	2	-	-
CO 5	3	3	-	2	2	-	-	-	2	2	-	-

Syllabus (PC AUE 502)

Introduction

Types of chassis layout with reference to power plant locations and drive, Vehicle frames. Various types of frames. Constructional details, Materials. Testing of vehicle frames. Unitised frame body construction: Loads acting on vehicle frame, chassis lubrication, and calculation of stresses on sections.

Front Axle and Steering System

Types of front axles. Construction details. Materials. Front wheel geometry viz. Castor, Camber, King pin inclination, Toe-in Conditions for true rolling motion of wheels during steering. Steering geometry. Ackerman and Davis steering system. Constructional details of steering linkages. Different types of steering gear boxes. Steering linkages and layouts. Power and power assisted steering.

Drive Line, Final Drive and Differential

Effect of driving thrust and torque reactions. Hotch kiss drive, torque tube drive and radius rods. Propeller shaft. Universal joints. Constant velocity universal joints. Front wheel drive. Different types of final drive. Differential principles. Construction and working of differential non-slip differential. Differential locks.

Rear Axles

Construction of rear axles. Types of loads acting on rear axles. Full floating. Three quarter floating and semi floating rear axles. Rear axle housing. Construction of different types of axle housings. Multi-axled vehicles. Construction details of multi drive axle vehicles.

Suspension System

Need of suspension system- Types of front and rear suspension system- Suspension springs- Constructional details and characteristics of leaf, coil and torsion bar springs- Independent suspension– Pneumatic suspension- constructional details of telescopic shock absorbers. Types, vibrations and riding comfort, role axis of spring suspension.

Wheel & Tyres

Types of wheels, construction, wired wheels, tyres, construction, types, radial, bias & belted bias, comparison, slip angle, under and over steering, tread patterns, tyre re-treading cold and hot, tyre specification tubeless tyre.

Braking System

Necessity of brake, stopping distance and time. Brake efficiency, weight transfer, brake shoe theory, determination of braking torque, braking systems- mechanical, hydraulic, disc, drum, parking and emergency brakes, power, servo and electrical brakes, details of hydraulic system, mechanical system and components. Types of master cylinders, Anti-lock braking systems.

Safety Aspect

Different Safety aspect, Driver's safety, passive restraint systems, Use of air bags, side impact analysis. Bumper system. Energy absorbent foams. Mechanisms in vehicle applied to safety.

Interior Ergonomics

Driver and passenger ergonomics with seating space arrangements for cars. Different types of car seats. Seat comfort, split frame seating, seat adjustment mechanisms. Visibility, methods of improving visibility.

Body Materials

Different types of ferrous and non-ferrous materials used in vehicle such as cast iron. Steel, Alloy steel, plastic, G.R.P, semi-rigid polyurethane.

Painting

Corrosion of vehicle body. Anticorrosion method. Paint and painting process.

Books

1. Rjavee J.E., Automotive Technology- A System Approach, 3rd Edition, Thomson Asia Pte Ltd., Singapore, 2004.

2. De A., Automobile Engineering, Galgotia Publishers Pvt. Ltd., 2004.

3. Ramalingam K.K., Scitech Publication (India) Pvt. Ltd., 2nd Edition, 2004.

4. Heitner J., Automotive Mechanics Principle and Practice, 2nd Edition, East West Press, 1999.

5. Powloski J., Vehicle Body Engineering, Business Books Ltd., London, 198

Department of Automobile Engineering

PC – AUE 503: Heat Transfer

Subject Code : PC-AUE503
Category : Professional Core Courses
Subject Name : Heat Transfer
Semester : Fifth
L-T-P : 3-1-0
Credit :4
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students Will be able to:

CO1	Apply one dimensional steady (with and without heat generation) as well as unsteady state (without heat generation) heat conduction concepts to evaluate the effectiveness and efficiency of rectangular and pin fins installed on a surface and understand Biot number to analyse transient heat conduction problems.
CO2	Analyse the physical significances of the pertinent dimensionless numbers (i.e., Reynolds no, Nusselt no, Prandtl no, Grashoff no, Peclet no, Rayleigh no etc.) governing the forced and natural convective heat transfer empirical equations.
CO3	Explain the physical mechanisms that governs the thermal radiation process between different planetary objects along with different types of surfaces.
CO4	Design the industrial heat exchangers based on the heat transfer rate both theoretically and practically.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	1	1	1	-	-	-	-	2
CO 2	3	3	3	3	2	-	-	-	-	-	-	3
CO 3	3	3	3	3	2	-	1	1	-	-	-	2
CO 4	3	3	3	3	1	1	2	2	1	1	2	2

Syllabus (PC AUE 503)

Introduction

Modes of heat transfer.

Conduction

Fourier law of heat conduction for isotropic material. Thermal conductivity. Derivation of the energy equation in three dimensions including transient effect. Non-dimensional - thermal diffusivity and Fourier number. One dimensional solution with and without heat generation in slab, cylinder and sphere. Analogy with electrical circuits. Critical thickness of insulation.

Fins

Heat flow through rectangular fin, Heat dissipation from an infinitely long fin, fin insulated at tip and fin losing heat at the tip, efficiency and effectiveness of fin, Biot number, estimation of error in temperature measurement in a thermometer well.

Conduction-Unsteady state

Lumped parameter approach and physical significance of time constant, Biot number, Validity of lumped parameter approach. Introduction to Heissler Chart.

Radiation

Concept of radiation, absorptivity, reflectivity & transmissivity, black, white and grey surfaces, emissive power & emissivity. Intensity of radiation & solid angle, Laws of radiation –Planck's Law, Stefan–Boltzmann Law, Wein's displacement Law, Kirchhoff's Law, Lambert's cosine law. Radiation exchange between black bodies and concept of shape factor. Radiation exchange between nonblack Bodies, heat exchange between two grey surfaces, electrical analogy, radiation shield.

Convection

Introduction, Newton's law of cooling and significance of the heat transfer coefficient. Momentum and energy equations into dimensions, importance of non-dimensional quantities and their physical significance. Order of magnitude analysis for flow over a flat plate. Velocity and thermal boundary layer thickness by integral method. Analogies between momentum, heat and mass transfer.

Heat exchangers

Types, Heat exchanger analysis, LMTD for parallel & counter flow heat exchanger, overall heat transfer coefficient, fouling, correction factor for multi-pass arrangement, effectiveness and number of transfer unit for parallel and counter flow heat exchanger.

Books

1. Ozisik M.N., Heat Transfer- A Basic Approach, McGraw Hill.

2. Holman J.P., Heat Transfer, 8th Ed., McGraw Hill.

3. Rajput R.K., Heat and Mass Transfer, S. Chand, 2010.

4. Sachdeva R.C., Fundamental of Engineering Heat and Mass Transfer, New Age Science, 2010.

PC – AUE 504: Design of Machine Element

Subject Code : PC-AUE 504
Category : Professional Core Courses
Subject Name : Design of Machine Element
Semester : Fifth
L-T-P : 3-1-0
Credit : 4
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Apply the failure theories for designing conditions under static and dynamic load conditions.
CO2	Analyze the design of shafts, springs, sliding, rolling contact bearings under static and fatigue load conditions.
CO3	Evaluate the design of Spur, helical, bevel and worm gears from strength and wear consideration.
CO4	Design threaded fasteners, pre-loaded bolts and welded joints, clutches, brakes along with power screws and couplings.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	3	3	3
CO 4	2	2	2	2	2	2	2	2	2	2	2	2

Syllabus (PC AUE 504)

Module 1
Design considerations- limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure).

Module 2
Design of shafts under static and fatigue loadings.

Module 3
Analysis and design of sliding and rolling contact bearings.

Module 4
Design of transmission elements: spur, helical, bevel and worm gears; belt and chain drives.

Module 5
Design of springs: helical compression, tension, torsional and leaf springs

Module 6
Design of joints: threaded fasteners, pre-loaded bolts and welded joints

Module 7
Analysis and applications of power screws and couplings

Module 8
Analysis of clutches and brakes

Books

Learning Resources

1. Shigley J.E. and Mischke C.R., Mechanical Engineering Design, 5th Edition, McGraw-Hill International, 1989.
2. Deutschman D., Michels W.J. and Wilson C.E., Machine Design Theory and Practice, Macmillan, 1992.
3. Juvinal R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4. Spottes M.F., Design of Machine Elements, Prentice-Hall India, 1994.
5. Norton R.L., Mechanical Design – An Integrated Approach, Prentice Hall, 1998.
6. Sadhu Singh, Machine Design, Khanna Book Publishing House, 2016.

HM-HU 511A: Values & Ethics

Subject Code : HM-HU 511A
Category : Humanities and Social Sciences including Management Courses
Subject Name : Values & Ethics
Semester : Fifth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Learn the principles of different types of value and their importance.
CO 2	Learn about the sustenance of value in the process of social, political and technological system.
CO 3	Learn about the concept of ethics and its application in practical life.
CO 4	Learn about the application of values and ethics in the field of engineering.

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	3	3	2	-	3	3	3	3	2	-	3
CO2	-	2	2	2	-	3	3	3	2	1	2	3
CO3	-	2	1	2	-	3	3	3	2	1	3	3
CO4	2	3	3	3	2	3	3	3	2	1	3	3

Syllabus (HMHU 511A)

1. Definition and classification of values: Extrinsic values, Universal and Situational values, Physical, Environmental, Sensuous, Economic, Social, Aesthetic, Moral and Religious values.
2. Concepts related to values: Purusartha, Virtue, Right, duty, justice, Equality, Love and Good.
3. Egoism, Altruism and universalism. The Ideal of Sarvodaya and Vasudhaiva Kutumbakam.
4. The Problem of Sustenance of value in the process of Social, Political and Technological changes.
5. The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi.

Books

1. Kapoor, P., Professional Ethics and Human Values, Khanna Publishing House, 2019.

2. Little W., An Introduction of Ethics, Allied Publisher, Indian Reprint, 1955.

3. William K.F., Ethics, Prentice Hall of India, 1988.

4. Pradhan A. and Vichara M., B.H.U., Varanasi.

HM-HU 511B: Education, Technology & Society

Subject Code : HM-HU 511B
Category : Humanities and Social Sciences including Management Courses
Subject Name : Education, Technology & Society
Semester : Fifth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Understand the necessity of education on human life and society.
CO 2	Differentiate the different nature, scope and approaches of learning & education.
CO 3	Analyse the impact of technology transfer and technology management on society
CO 4	Develop ethical values from education and technology to spread among different individuals and society.

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	3	2	2	-	3	3	3	3	2	-	3
CO2	-	2	2	2	-	3	3	3	2	1	-	3
CO3	3	2	1	2	3	3	3	3	2	1	2	3
CO4	-	3	2	2	-	3	3	3	2	1	-	3

Syllabus (HMHU 511B)

1. Necessity of education for human life, Impact of education on society.
2. Nature and scope of education (Gurukul to ICT driven), Emotional intelligence Domains of learning, Approaches to learning, Learning outcomes.
3. Role of education in technology advancement.
4. Technology and society; management of technology; technology transfer
5. Ethical and value implications of education and technology on individual and society.

Books

1. Russel B., Education and Social Order.
2. Bower and Hilgard, Theories of Learning.
3. Harrington J.L., Technology and Society.

PC-AUE591: Fluid Mechanics & Heat Transfer Lab

Subject Code : PC-AUE591
Category : Professional Core Courses
Subject Name : Fluid Mechanics & Heat Transfer Lab
Semester : Fifth
L-T-P : 0-0-3
Credit : 1.5
Stream : B. Tech (AUE)
Full Marks : 100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Calculate the discharge of Venturimeter and Orificemeter and thereafter find the friction factor during flow through pipes.
CO 2	Apply the fluid mechanics laws to find the performance characteristics of Pelton Wheel, Centrifugal Pump and Pitot tube.
CO 3	Analyse the principle of conduction, convection and radiation heat transfers through different experimental setups.
CO 4	Evaluate the performance characteristics of Heat Exchangers and Vapour Compression Refrigeration System.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	2	2	2	3	3	2	2	2	-	3
CO2	3	2	2	2	-	3	1	2	2	1	-	3
CO3	3	2	1	2	3	3	2	1	1	1	2	2
CO4	3	3	2	2	-	3	2	2	2	1	-	3

Syllabus (PC-AUE591)

1. Measurement of co-efficient of discharge of given orifice and Venturimeter.
2. Determination of the co-efficient of friction factor for flow through pipes.
3. Determination of the performance characteristics of a centrifugal pump.
4. Determination of the performance characteristics of Pelton Wheel.
5. Determine the flow rate and velocity profile in a duct using pitot tube.
6. Determination of thermal conductivity of a metal rod and/or insulating powder materials.
7. Heat transfer through forced convection.
8. Heat transfer through natural convection from a vertical surface.
9. Determination of the convective heat transfer coefficient for flow over a heated plate
10. Measurement of emissivity in a test surface.
11. Experiment with a parallel flow and a counter flow heat exchanger.
12. Determination of the performance characteristics of a vapour compression system
13. Heat transfer through a pin fin.

Books

1. Fluid Mechanics and Machinery, R.K.Bansal, Laxmi Publication.
2. Introduction to Fluid Mechanics & Fluid Machines, Som and Biswas, TMH.
3. A Textbook on Fluid Mechanics and Machines, S.Pati, McGrawHill.
4. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010.
5. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House.

PC-AUE592: Automobile Engineering Lab I (Engine & Chassis Component Lab)

Subject Code : PC-AUE 592
Category : Professional Core Courses
Subject Name : Automobile Engineering Lab I (Engine & Chassis Component Lab)
Semester : Fifth
L-T-P : 0-0-3
Credit : 1.5
Stream : B. Tech (AUE)
Full Marks : 100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Understand the working formula, specifications of the various types of modern engine system, fuel injection system, cooling system, lubricating system & also the various components of chassis & transmission system along with the different types of tools used during the experiment.
CO 2	Dismantle and assemble the modern automobile engines and study constructional features and working principle of fuel supply system, air intake system, cooling system, lubrication system and ignition system, braking system, clutch system & other related systems.
CO 3	Analyze the differences of 4 strokes Petrol and Diesel Engines to develop modern sustainable systems and also along with different types of components related to the braking system, steering systems & transmission system.
CO 4	Evaluate the different types of efficiencies by performing the relevant data tabulation, calculations and graphs and thereafter develop and modify the geometrical features of Petrol and Diesel Engines and along with other chassis components.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	3	2	3	2	-	-	3	-	-	3
CO2	3	2	2	3	3	-	2	2	2	1	-	2
CO3	3	2	2	2	3	2	2	2	2	2	2	2
CO4	3	3	2	3	3	2	-	-	2	-	2	3

Syllabus (PC AUE 592)

1. Dismantling, measurement, inspection and assembling of different modern engine [like Multipoint fuel injection (MPFI) and Common rail injection (CRI) engines and Digital twin spark ignition (DTSI) etc.] engine for passenger car, commercial vehicle and two-wheeler engines.

2. Study of fuel supply system (SI and CI) and structure and testing of common rail high pressure injectors.

3. Dismantling, assembling and testing of different types of Fuel injection Pumps such as distributor type, high pressure pump.

4. Electronic ignition and battery ignition system with accessories.

5. Study of cooling, lubrication.

6. Study and testing of automotive air conditioning system.

7. Dismantling and assembling of different types of clutches.

8. Dismantling and assembling of different types of Gear.

9. Dismantling and assembling of different Steering system and study of driver seat.

10. Study of Frames used for Heavy commercial vehicle (HCV), Car, Two & Three Wheelers and Dismantling and assembling of Suspension system.
11. Dismantling and assembling of Braking system, Brake adjustment and brake bleeding.

12. Dismantling and assembling of Wheels and Tyres.

13. Dismantling and assembling of Propeller Shaft, Universal Joints and Differential.

Books

1. Ganesan V., Internal Combustion Engines, Tata McGraw Hill Co., Third Edition, 2007.

2. Heywood J.B., Internal Combustion Engine Fundamentals, McGraw Hill Book Co., New York, 1989.

3. Textbook of Automobile Engineering, R.K Rajput, Laxmi Publications (P) Ltd.

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PC-AUE593: Automobile Engineering Lab II (ETPM Lab)

Subject Code : PC-AUE593
Category : Professional Core Courses
Subject Name : Automobile Engineering Lab II (ETPM Lab)
Semester : Fifth
L-T-P : 0-0-3
Credit : 1.5
Stream : B. Tech (AUE)
Full Marks : 100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Understand the governing parameters of Engine Testing & Performance, MPFI Systems, Valve timings & adjustment & also characteristics of fuel & oils.
CO 2	Perform the performance test, Morse test, heat balance of SI & CI engine, flash & fire point of an oil & also examine the calorific value of fossil fuels.
CO 3	Distinguish the exhaust emission characteristics, methods of heat balance & also performances with different types of advance IC engine.
CO 4	Evaluate the numerical rules for all the experiments which has been performed throughout by the process of relevant data tabulations, calculations and graphs.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	3	3	1	1	2	1	-	-	-	3
CO2	3	2	3	3	3	3	3	3	3	3	2	2
CO3	3	3	2	2	2	2	2	-	-	-	2	2
CO4	3	2	3	3	-	-	-	-	-	-	-	3

Syllabus (HMHU 511B)

1. Valve Timing Diagram for Four Stroke Engine
2. Valve Timing Diagram for Two Stroke Engine
3. Studying the components and working principle of an MPFI engine
4. Performance test and energy balance on MPFI engine at different load conditions.
5. Performance test and energy balance on 2-Stroke Petrol engine at different load conditions.
6. Performance test and energy balance on 2-Stroke Diesel Engine at different load conditions.
7. Performance test and energy balance on 4-Stroke Petrol engine at different load conditions.
8. Performance test and energy balance on 4-Stroke Diesel Engine at different load conditions.
9. Morse test on petrol engine.
10. Determination of flash and fire point of fuels and lubricating oil.
11. Determination of calorific value of different types of fuel by Bomb calorimeter.
12. Measurement of pollutants emitted from the vehicle by gas analyzer/ Orsat apparatus/ smoke meter.

Books

1.Ganesan V., Internal Combustion Engines, Tata McGraw Hill Co., Third Edition, 2007.
2. Heywood J.B., Internal Combustion Engine Fundamentals, McGraw Hill Book Co., New York, 1989.

Department of Automobile Engineering

PW-AUE581: Project-I

Subject Code : PW-AUE581
Category : Mini Project
Subject Name : Project-I
Semester : Fifth
L-T-P : 0-0-0
Credit : 1
Stream : B. Tech (AUE)
Full Marks :100 (End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Get Exposure to research and development.
CO 2	Generate and implement innovative ideas for social benefit.
CO 3	Develop Algorithms/Programs/Prototype/Models.
CO 4	Solve the industrial problems at various stages.

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	2	3	3	3	2	2	1	3	2	2	1
CO2	3	1	2	2	3	3	3	3	2	2	2	3
CO3	3	2	3	3	3	3	3	2	3	3	2	2
CO4	3	2	2	3	3	2	2	1	3	3	3	2

Department of Automobile Engineering

6th Semester

PC-AUE601: Automotive Transmission

Subject Code : PC-AUE601
Category : Professional Core Courses
Subject Name : Automotive Transmission
Semester : Sixth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Understand the construction, working principle and performance of various types manual, semi-automatic, automatic transmission, and various hydrostatic and electric drive of an Automobile.
CO 2	Formulate the equation for torque capacity of different types of frictional clutch, gear ratios of different types of gear boxes.
CO 3	Analyze the performance characteristics of various types of manuals, semi-automatic and automatic transmission components and studied the improvements on transmission efficiency.
CO 4	Calculate the amount of torque transmitted during various types of frictional clutch engagement and disengagement process, gear ratio for vehicles employed with different gear boxes, speed of the different components of the Epicyclic Gear boxes.
CO 5	Design the different types of frictional clutches, different types of selective gear boxes, hydrostatic and electric drives.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	-	1	-	-	-	-	2
CO2	3	3	-	-	-	-	-	-	-	-	1	-
CO3	3	3	-	2	2	-	-	-	-	1	-	1
CO4	3	3	2	-	-	-	-	-	-	-	-	1
CO5	3	3	3	3	2	2	2	3	3	2	2	-

Syllabus (PC-AUE 601)

Clutch

Requirements, Types- Construction, working and operating characteristics of single plate clutch, multi plate clutch, semi centrifugal, centrifugal clutch. Construction and working of cone clutch, electromagnetic clutch, over running clutch. Clutch linkage – mechanical and hydraulic. Clutch energy dissipated. Clutch lining materials, deriving the equation for torque capacity of a single plate and multi-plate clutch. Problems involving torque capacity and axial force of single plate and multi-plate clutch, trouble shooting, service procedure.

Gearbox

Necessity. Construction and working of sliding mesh, constant mesh, synchromesh gearbox. Over drive mechanism. Gear shift mechanisms, total resistance to motion-traction and tractive effort - acceleration - calculation of gear ratio for vehicles - design of three speed gear box and four speed gear boxes, performance characteristics in different speeds. Speed synchronizing devices, gear materials, gear lubrication. Transfer case, Problems in gear box involving gear ratios and various gradients and total resistance calculation. Design the clutch and gear box for a given engine

Hydrokinetic Fluid coupling and Torque converter

Introduction to fluid coupling, Fluid coupling - construction and principle of operation, Drag torque and various drag reducing devices, Performance characteristics of fluid coupling, Problems on design and torque capacity of fluid coupling, torque converter and converter coupling - construction and principle of operation. Torque converter performance terminology, multistage torque converter – construction and working, Poly phase torque converter, Performance characteristic of multistage and poly phase torque converters.

Automatic Transmission

Relative merits and demerits when compared to conventional transmission, Principle of working of epicyclic gear train, Planetary gear box - construction and working, Automatic gear box consideration, Three speed & reverse transaxle and four speed & reverse longitudinal mounted automatic transmission mechanical power flow, Fundamentals of a hydraulic control system and basic principle of a hydraulic control gear shift mechanism for automatic transmission, Electronic–hydraulic control automatic transmission, continuously variable transmission, semi- automatic transmission system. Problems in automatic transmission involving gear ratio. Hydrostatic Drives and Electric Drives: Introduction to hydrostatic drives, working principle and types of hydro static drives, Advantages and limitations of Hydrostatic drive, Comparison of hydrostatic drive with hydro dynamic drive, Construction and working of Janny Hydrostatic drive. Introduction to Electric drive and Layout of Electric drive, Principle of Early Ward Leonard control system of electric drive, Principle of Modified Ward Leonard control system of electric drive, Advantages, limitations and performance characteristics of electric drive.

Different Automatic Transmission

Automated Manual transmission, S-Tronic transmission, Dual Clutch Transmission, Direct shift gear box (DSG), Tiptronic transmission, electronic control transmission integrated intelligent control system (ECTi).

Books

Learning Resources

1. Giri N.K., Automobile Mechanics, Khanna Publishers, New Delhi
2. Crouse W.H. and Anglin D.L., Automotive Transmission and Power Train Construction, McGraw Hill.
3. Naunheimer H., Bertsche B., Ryborz J. and Novak W., Automotive Transmission: Fundamentals, Selection, Design and Application, 2nd Edition, Springer, 2011

Department of Automobile Engineering

PC AUE 602: Hybrid & Electric Vehicles

Subject Code : PC-AUE 602
Category : Professional Core Courses
Subject Name : Hybrid and Electric Vehicles
Semester : Sixth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Understand the importance of hybrid electric vehicles and the basic difference between conventional and Hybrid vehicles.
CO 2	Explain the different configurations and controlling mechanism of electric drives.
CO 3	Calculate the capacity of the energy storage system in Hybrid electric vehicles.
CO 4	Analyse the different energy management strategies for Hybrid Electric Vehicles.
CO 5	Design the hybrid electric vehicles & battery electric vehicles.

CO-PO Mapping

Syllabus (PC-AUE 602)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	2	1	1	-	-	2	1
CO2	3	2	2	1	1	-	1	1	1	1	2	-
CO3	3	3	3	2	2	2	-	1	2	1	2	1
CO4	3	2	2	2	-	2	2	2	-	-	2	2
CO5	3	-	3	2	2	-	2	2	3	2	2	2

Introduction to Hybrid Electric Vehicles

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Conventional Vehicles

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Hybrid Electric Drive-trains

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis

Electric Drive-trains

Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Electric Propulsion unit

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of different motors drives like DC motor drives, Induction Motor drives etc.

Energy Storage

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Ultra capacitors and ultra-flywheels energy storage system. Hybridization of different energy storage devices.

Sizing the drive system

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

Energy Management Strategies

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies.

Case Studies

Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Books

Learning Resources

1. Husain I., Electric and Hybrid Vehicles: Design Fundamentals, CRC Press.

2. Ehsani M., Gao Y., Gay S.E. and Emadi A., Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press.

3. Larminie J. and Lowry J., Electric Vehicle Technology Explained, Wiley.

PE AUE 611A: Electronic Vehicle Management System

Subject Code : PE-AUE 611A
Category : Professional Elective Courses
Subject Name : Electronic Vehicle Management System
Semester : Sixth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Understand the importance of sensors and transducers used in the SI Engine and Diesel Engine Management Systems.
CO 2	Apply the different concepts of Electronic Fuel Injection Systems used for SI Engines.
CO 3	Analyse the methodologies of EGR, SCR and CRDI systems in CI Engine Management Systems.
CO 4	Evaluate the various components of Electronic ABS, Steering Systems, Vehicle Security Systems, Vehicle Tracking Systems and Ventilation and Air Conditioning Systems used in modern Automotives.
CO 5	Differentiate between the modern and conventional Automotives by the introduction of Vehicle Network and Communication Systems.

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	2	2	2	2	1	1	-	-	2	1
CO2	3	2	2	2	3	2	1	1	1	1	2	-
CO3	3	3	3	2	2	2	-	1	2	1	2	1
CO4	3	2	2	2	3	2	2	2	-	-	2	2
CO 5	2	2	3	2	1	-	-	-	-	2	2	3

Syllabus (PE-AUE 611A)

Sensors

Inductive, Hall effect, hot wire, thermistor, piezo electric, piezo-resistive, based sensors. Throttle position, mass air flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, crash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors, gyro sensors etc.

SI engine management system

Layout and working of SI engine management systems. Group and sequential injection techniques. Sensors and actuators in SI engine management system, Multipoint fuel injection system (MPFI), Gasoline direct injection (GDI) system, advantages of GDI system, Working of GDI system. Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff, Fuel control maps, open loop control of fuel injection and closed loop lambda control, Transistorized ignition and Electronic ignition systems and spark timing control, Dwell angle calculation, ignition timing calculation, Closed loop control of knock, Variable valve timing technology, Cam-less engine, Stratified charge engine, Three way and NOx storage catalytic converter.

Diesel engine management system

Exhaust gas management for passenger cars, diesel oxidation catalytic converter, storage catalytic converter, Selective catalytic reduction (SCR) system, particulate filter system, New and advanced technologies in Diesel fuel injection, Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, injection duration calculation, High pressure fuel pump, Rail, flow limiter, EGR system, Sensors and actuators in CI engine management system.

Vehicle management system

Electronic braking system, fail safe braking system, Anti-lock brake system (ABS) - its need, layout construction and working. Electronic control suspension – Damping control, Electric power steering, electronic system for activating air bags, Crash sensor, Seat belt tightening, Cruise control, electronic stability program, Vehicle security systems- alarms, Vehicle tracking system. Collision avoidance Radar warning system, Traction control system, Power window, adaptive noise control, electric seats,

Anti-theft system, Tyre pressure monitoring system, Lane departure warning system, Blind spot detection, Heating, Ventilation and Air Conditioning Systems (HVAC). Electronic Outside Rear View Mirror, Rain Sensing Wiper System, Automatic Climate Control, Adaptive Head Light, Night Vision Assist, Traffic Jam Assist, Drive by Wire System.

Vehicle network and communications system

Introduction to Vehicle On-board System (VOS), Mobile Data Terminal (MDT), Controller Area Network (CAN), Wireless Sensor Network, Design and difference of various bus system, GPS technology on Vehicle, Radio Frequency Identification (RFID), Smart mobile phone and Personal digital assistant (PDA), Mobile and Satellite Communications Infrastructure, Cyber-cars.

Books

Learning Resources

1. Ribbens W.B., Understanding Automotive Electronics, 6th Edition, Newnes, 2003.

2. Brady R.N., Automotive computers and Digital Instrumentation, A Reston Book, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.

3. BOSCH, Automotive Handbook, 6th Edition, Bentley publishers.

4. Bosch R., Diesel Engine Management, SAE Publications.

5. Bosch R., Gasoline Engine Management, SAE Publications.

6. Hollembeak B., Automotive Electricity, Electronics and computer controls, Delmer Publishers.

7. Denton T., Automotive Electronics, SAE.

Department of Automobile Engineering

PE AUE 611 B: Transport Management& Motor Vehicles Act

Subject Code : PE-AUE 611B
Category : Professional Elective Courses
Subject Name : Transport Management & Motor Vehicles Act
Semester : Sixth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Understand the various Acts related to Motor Vehicles.
CO2	Explain the methods of vehicle registration, insurance, taxation and renewal processes and road safety.
CO3	Elaborate the various of Passenger Transport Operation & Goods Transport Operation, their problems & controlling.
CO4	Analyse and implement the advanced techniques in Traffic Management.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	3	2	3	-	-	-	2
CO 2	3	-	-	-	-	3	2	2	-	2	-	2
CO 3	3	2	2	2	2	3	2	2	2	2	2	-
CO 4	3	3	-	-	3	2	2	-	-	2	-	-

Syllabus (PE AUE 611 B)

Motor Vehicle Act

Short titles & definitions, Laws governing to use of motor vehicle & vehicle transport, Licensing of drivers & conductors, Registration of vehicle, State & interstate permits, Traffic rules, Signals & controls, Accidents, Causes & analysis, Liabilities & preventive measures, Rules & regulations, Responsibility of driver, Public & public authorities, Offences, penalties & procedures, Different types of forms, Personnel, Authorities & duties, Rules regarding construction of motor vehicles, Tourist and National Permits, Fitness of a Motor Vehicle, Rules for Special Purpose Vehicle (Off Road vehicle, Specially designed vehicle, Government Department Vehicle).

Taxation

Objectives, Structure & methods of laving taxation, One-time tax, Tax exemption & tax renewal, Types of Tax, Different types of Tax at Vehicle Registration Renewal.

Insurance

Insurance types & significance, Comprehensive plus zero depreciation, Third party insurance, Furnishing of particulars of vehicles involved in accident, MACT (Motor Accident Claims Tribunal), Solatium Fund, Hit & Run case, Duty of driver in case of accident, Surveyor & Loss Assessor, Surveyor's report, Role of Surveyor, Settlement of Insurance and Procedure of Investigation.

Passenger Transport Operation

Structure of passenger transport organizations, Typical depot layouts, Requirements and Problems on fleet management, Fleet maintenance, Planning - Scheduling operation & control, Personal & training-training for drivers & conductors, Public relations, Propaganda, publicity and passenger amenities, Parcel traffic, Theory of fares-Basic principles of fare charging, Differential rates for different types of services, Depreciation & debt charges, Operation cost and Revenues, Economics & records, Maintenance management of State Transport Undertaking (STU), Bus Rapid Transport system (BRTS).

Goods Transport Operation

Scheduling of goods transport, Management Information System (MIS) in passenger/ goods transport operation, Storage & transportation of petroleum products, Intelligent Transport System (ITS).

Advance Techniques in Traffic Management

Traffic navigation, Global positioning system.

Books

1. Motor Vehicle Act, Government of India Publications.

2. Bhandarkar S.L., Vehicle Transport Management, Dhanpat Rai & Co., 2016.

3. Gupta R.B., Transport Management, Satya Prakashan, 2016

4. CMVR-1989.

5. White P.R., Public Transport: Its Planning, Management and Operation, Natural and Built Environment Series, Kindle Edition, September 2008.

6. Doke J., Fleet Management, McGraw Hill Co., 1984.

7. Kitchin L.D., Bus Operation, 3rd Edition, Illiffe and Sons Co., London.

HM-HU 611A : Introduction to Industrial Management

Subject Code : HM-HU 611A
Category : Humanities and Social Sciences including Management courses
Subject Name : Introduction to Industrial Management
Semester : Sixth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Define the fundamental knowledge of industrial management.
CO2	Explain the theory and functions of human resource management.
CO3	Apply the appropriate tools or techniques to increase the productivity of an organization.
CO4	Select appropriate quality control tools and sampling plan to optimize productivity.
CO5	Decide critical path and predict project completion time of the project

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	2	1	-	-	-	1	2
CO 2	3	-	1	1	2	2	-	-	-	-	-	1
CO 3	3	2	1	1	3	2	1	2	1	-	2	3
CO 4	3	3	2	2	2	2	2	2	2	1	2	3
CO 5	3	3	3	3	2	2	-	2	3	2	3	3

Syllabus (HM HU 611 A)

Introduction

Concept and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership. Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Social responsibilities of Management, Introduction to Human resources management: Nature of HRM, functions and importance of HRM.

Work Study

Introduction, definition, objectives, steps in work study, Method study: definition, objectives, steps of method study, Work Measurement: purpose, types of study- stopwatch methods- steps-allowances- standard time calculations- work sampling, Production Planning and Control Inventory Control: Inventory, Cost, Models of inventory control: EOQ, ABC, VED.

Quality Control

Statistical quality control, Control charts for variables and attributes, Acceptance Sampling- Single sampling- Double sampling plans, Introduction to TQM.

Project Management

Project Network Analysis, CPM, PERT and Project crashing and resource leveling.

Books

1. Sharma S.C. and Banga T.R., Engineering Management (Industrial Engineering & Management), Khanna Book Publishing Co. (P) Ltd., New Delhi.

2. Khanna O.P., Industrial Engineering and Management, Dhanpat Rai Publications Ltd.

3. Selvam P., Production & Operation Management, PHI.

4. Raju N.V.S., Industrial Engineering Management, Cengage Learning.

5. Shankar R., Industrial Engineering Management I, Galgotia.

HM-HU 611B: Quantitative Methods for Decision Making

Subject Code : HM-HU 611B
Category : Humanities and Social Sciences including Management Courses
Subject Name : Quantitative Methods for Decision Making
Semester : Sixth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Understand different types of quantitative methods and apply linear programming tools for decision making in various types of industries.
CO2	Use transportation problems to minimize cost and understand the principles of assignment of jobs and machines to optimize production time and production costs.
CO3	Analyze the principles of several inventory models and queuing models for MRP-I & MRP-II.
CO4	Decide critical path and predict project completion time of the project using PERT/CPM techniques.

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	2	-	1	1	1	1	1	3	3
CO2	3	3	3	3	3	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	1	1	1	2	3	3
CO4	3	3	3	3	3	-	-	-	-	-	3	3

Syllabus (HM HU 611 B)

Module 1

An overview to quantitative methods and probability: An analytical scientific approach to Problem solving modeling process for Managerial Decision Making.

Module 2

Decision making and quantitative techniques: Forecasting methods & Time Series Analysis, Decision Analysis: Decision Trees& Utility Theory, Decision Making under uncertainty, Decision Making under risk, Decision Making under certainty, Job sequencing.

Module 3

Linear programming formulation and solution: Linear Programming, Graphical & Simplex method, Dual simplex, Sensitivity Analysis & Duality. Transportation, Transshipment & Assignment Models.

Module 4

Inventory and queuing management: Inventory models (static, dynamic, probabilistic & stochastic), MRP I, MRP II. Waiting Line/ Queuing models steady state operation (M/M/1).

Module 5

Network models: Shortest route, maximal flow problem, PERT& CPM Techniques & Applications.

Books

Learning Resources

1. Riggs J.L., Production Systems: Planning Analysis & Control, John Wiley & Sons, 1981.
2. Bedi K., Production and Operations Management, Oxford University Press, 2004.
3. Taha H.A., Operations Research, Pearson, 9th Edition, 2014.
4. Sharma J.K., Operations Research –Theory and Application, 2nd revised Edition, Macmillan Publishers, 2003.
5. Vohra N.D., Quantitative Techniques in Management, 4th Ed., McGraw-Hill, 2010.

PC AUE 691: Automobile Engineering Lab-III (Automotive Design Lab)

Subject Code : PC – AUE 691
Category : Professional Core courses
Subject Name : Automobile Engineering Lab – III (Automotive Design Lab)
Semester : Sixth
L-T-P : 0-0-3
Credit : 1.5
Stream : B. Tech (AUE)
Full Marks : 100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Acquire basic knowledge on automobile part designing using design software apart from automobile production.
CO2	Use proper tool for designing automotive components.
CO3	Analyze various operations used in CATIA.
CO4	Design automotive components by using design tools.

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	1	1	1	2	2	3	3
CO2	3	3	3	3	3	-	-	-	-	-	3	3
CO3	3	3	2	2	3	-	1		1	2	3	3
CO4	3	3	2	3	3	1	2	2	2	2	3	3

Syllabus (PC AUE 691)

Module 1

Sketcher: Introduction to CATIA/CREO, History, Basics, GUI, Use of mouse buttons, Sketcher, constraints, profile, setting workbench, Standard toolbar, how to open sketcher, sketch details and important toolbar for sketch, Profile toolbar, Types of constraints, constraint application, constraint colour, Sketch constraint, view toolbar, Operation toolbar, Specification tree use, selecting toolbars, Sketch toolbar, Visualization toolbar. Toolbar setting, plane size setting, graphics properties toolbar.

Module 2

Part Design: Introduction to Design tools like Extrude; Revolve; Shell; Pad etc needed to generate solid models using CATIA/CREO software. Learning different tools of modelling software with exercise – Piston, Piston Pin, Connecting Rod, Crankshaft, Cylinder, Camshaft, Flywheel.

Module 3

Assembly Design: Assembly modelling of automotive mechanicals exercises – Piston - Connecting Rod – Crankshaft Assembly, Cam – Follower Assembly, Gear Assembly etc.

Books

1. CATIA V5R20 for Designers by Prof. Sham Purdue Tickoo

Department of Automobile Engineering

PC AUE 692: Automobile Engineering Lab IV (Vehicle Maintenance Lab)

Subject Code : PC – AUE 692
Category : Professional Core courses
Subject Name : Automobile Engineering Lab IV (Vehicle Maintenance Lab)
Semester : Sixth
L-T-P : 0-0-3
Credit : 1.5
Stream : B. Tech (AUE)
Full Marks : 100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Explain the process of brake bleeding, fuel system bleeding, wheel assembling, door assembling, wheel alignment and wheel balancing.
CO2	Solve the different issues related to the braking system, fuel injection system and tappet adjustment.
CO3	Analyze the different issues related to the braking system, fuel injection system and tappet adjustment.
CO4	Decide the particular tools which are required to use in particular maintenance process involved in vehicle maintenance.

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	2	2	2	1	2	3	3
CO2	3	3	2	3	3	-	-	-	2	-	2	3
CO3	3	2	2	2	2	-	1		1	1	2	2
CO4	3	3	3	3	3	1	2	2	2	2	3	3

Syllabus (PC AUE 692)

Contents (12 experiments/ studies/ problems are to perform/ solve from the list given below or relevant others)

1. Study of fuel filter (petrol & diesel) and air cleaner (dry & wet),
2. Study of fuel and brake bleeding.
3. Inspection of tyre and tube.
4. Study of BS-IV engine.
5. Tappet adjustment & valve timing diagram of four stroke engine
6. Study the air brake system & antilock braking system and their fault detection
7. Testing of a nozzle
8. Engine compression test
9. Maintenance of vehicle
10. Study of vehicle lifting machine
11. Study and experiment on wheel balancing machine
12. Study and experiment on wheel alignment machine
13. Study and experiment on head light focusing of vehicles
14. Under body inspection of vehicle either by lifting the vehicle or bringing the vehicle over underground inspection pits.

Books

1. Giri N.K., Automobile Mechanics, Khanna Publishers, New Delhi

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MC 681: Essence of Indian Traditional Knowledge

Course Code: MC601
Course Title: Essence of Indian Traditional Knowledge
L-T-P : 1-0-0
Category **:** Humanities and Social Sciences including Management courses
Semester : Sixth
Credit **:** 0
Stream **:** B. Tech. (AUE).
Full Marks : 100 (Sessional)

Course Outcome (CO)

Students will be able to:

CO 1	Ability to understand, connect up and explain basics of Indian Traditional knowledge and modern scientific perspective.
CO 2	Understand the Indian perspective of modern scientific world-view.
CO 3	Learn basic principles of Yoga.
CO 4	Lead holistic health care system.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	2	1	-	-	2
CO2	-	-	-	-	-	1	1	1	-	-	-	2
CO3	-	-	-	-	-	1	1	1	-	-	-	2
CO4	-	-	-	-	-	1	1	-	1	-	-	2

Syllabus (MC601)

1. Basic Structure of Indian Knowledge System (i) Veda (ii) Upa-Veda (iii) Vedanga (iv) Upanga
2. Modern Science and Indian Knowledge System
3. Yoga and Holistic Health care
4. Case Studies.

Books

1. Sivaramakrishna V. (Ed.), Cultural Heritage of India- Course Material, 5th Edition, Bharatiya Vidya Bhavan, Mumbai, 2014.

2. Jitatmanand S., Modern Physics and Vedant, Bharatiya Vidya Bhavan.

3. Capra F., Tao of Physics.

4. Capra F., The wave of Life.

5. Jha V.N., Tarkasangraha of Annam Bhatta (Eng. Trans), International Chinmay Foundation, Velliarnad, Amaku.

6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.

7. Jha G.N. and Jha R.N. (Ed.), Yoga-Darshanam with Vyasa Bhashya (Eng. Trans.), Vidyanidhi Prakasham, Delhi, 2016.

8. Jha R.N., Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016.

9. Sharma P.R., Shodashang Hridayam (English translation)

Department of Automobile Engineering

PW-AUE 681: Project-II

Subject Code : PW-AUE 681
Category : Mini Project
Subject Name : Project-II
Semester : Sixth
L-T-P : 0-0-0
Credit : 3
Stream : B. Tech (AUE)
Full Marks : 100 (End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Get Exposure to research and development.
CO 2	Generate and implement innovative ideas for social benefit.
CO 3	Develop Algorithms/Programs/Prototype/Models.
CO 4	Solve the industrial problems at various stages.

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	2	3	3	3	2	2	1	3	2	2	1
CO2	3	1	2	2	3	3	3	3	2	2	2	3
CO3	3	2	3	3	3	3	3	2	3	3	2	2
CO4	3	2	2	3	3	2	2	1	3	3	3	2

Department of Automobile Engineering

7th Semester

PC-AUE 701: Vehicle Dynamics

Subject Code : PC - AUE 701
Category : Professional Core Courses
Subject Name : Vehicle Dynamics
Semester : Seventh
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech. (AUE).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to

CO 1	Understand Vehicle System Dynamics.
CO 2	Evaluate the driving and braking resistances and their influences on vehicle dynamics.
CO 3	Analyze the dynamics systems such as suspension systems, braking system, steering mechanisms and stability of the vehicle.
CO 4	Solve different engineering problems related to the dynamics of vehicle.
CO 5	Develop the different optimization technique to minimize the drag and visualize the air flow over the vehicle body surface.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	2	-	-	-	2	-	-	-	2
CO3	3	3	-	2	1	-	-	-	-	-	-	-
CO4	3	3	2	3	2	2	2	2	2	2	-	2
CO5	3	3	3	2	3	3	1	2	1	-	2	3

Syllabus (PC AUE 701)

Resistance to Motion

Air gradient and Friction resistance, Tractive effort Draw bar pull, Tractive effort vs speed graph, Gear Ratio Selection, Power calculation of vehicle.

Aerodynamic Effect

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.

Stability of vehicle

Stability analysis, when vehicle is moving on level ground, reaction and maximum Tractive effort for the front wheel, rear wheel and all-wheel drive vehicle. Stability analysis when vehicle traveling on both longitudinally and laterally inclined road, stability of vehicle when taking turn on level and inclined road.

Forces on suspension

Load on suspension in force and apt direction, Load on suspension both for rigid and independent suspension system, Effect of braking and acceleration on suspension. Conditions for maximum load on suspension, considering gyroscopic effect, stability of 2 wheelers and 3-wheeler vehicle.

Vehicle Handling

Slip angle, over steer and under steer and its relation with slip angle, Ackerman angle, Steady state and transient cornering, Lateral force developed during cornering. Cornering stiffness, Power consumed by tyre.

Effect of braking

Braking torque inside the drum brake and disc brake system, Force analysis on brake pedal, master cylinder and wheel cylinder, Wheel braking torque on the surface of tyre, requirement of antilock braking system.

Gyroscope

Precisional motions and gyroscopic stability, gyroscopic couple, effect on stability of four- and two-wheel vehicle.

Riding characteristic

Effect of inflation pressure on tyre, tyre life, tyre wear. Over loading and wrong loading Driving habit, Wheel wobble and its effect.

Books

Learning Resources

1. Giri N.K., Automobile Mechanics, 8th Edition, Khanna Publication, 2006.
2. Giri N.K., Automotive Technology, 1st Edition, Khanna Publication, 2004.
3. Gupta K.M., Automobile Engineering, Vol. I & II, 1st Edition, Umesh Publication, 2006.
4. De. A., Automobile Engineering, Revised Edition, Galgotia Publications Pvt. Ltd., 2010.
5. De. A., Vehicle Dynamics, Galgotia Publications Pvt. Ltd., 2010.
6. Pacejka H., Tire and Vehicle Dynamics, Elsevier, 2012.

Department of Automobile Engineering

PE AUE 711 A: Alternate Fuels & Energy Systems

Subject Code : PE – AUE 711A
Category : Professional Elective Courses
Subject Name : Alternate Fuels and Energy Systems
Semester : Seventh
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech. (AUE).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcomes

Students will be able to:

CO1	Understand the important properties, general characteristics of the fuel, thermodynamics & chemical reaction during the fuel combustion and requirements of alternative fuels.
CO2	Explain the combustion characteristics, emission characteristics, production methodology, processing for storage &safety handling procedures of different types of Alternative Fuels I & II.
CO3	Identify the reasons for automobile emission formation and elaborate the practical practices for governing those emissions from the SI & CI engines.
CO4	Analyse the different test procedures to control the engine emissions from SI & CI engines & discuss the various types of instruments to conduct these tests.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	-	3	2	2	-	2	2	3
CO 2	3	2	3	3	3	2	2	2	2	2	3	3
CO 3	3	3	-	-	3	3	3	2	2	2	2	3
CO 4	3	3	3	3	3	2	2	2	2	2	3	3

Syllabus (PE AUE 711 A)

Conventional Fuels and Need for alternative fuels

Estimate of petroleum reserve and availability- comparative properties of fuels- diesel and gasoline, quality rating of SI and CI engine fuels, fuel additives for SI and CI engines, thermodynamics of fuel combustion- introduction to chemical thermodynamics, chemical reaction- fuels and combustion, enthalpy of formation and enthalpy of combustion, first law analysis of reacting systems, adiabatic flame temperature, need for alternative fuels, applications, types etc.

Alternative Fuels I

Gaseous Fuels and Biofuels: Introduction to CNG, LPG, ethanol, vegetable oils, bio-diesel, biogas, Hydrogen and HCNG, study of availability, manufacture, properties, storage, handling and dispensing, safety aspects, engine/ vehicle modifications required and effects of design parameters performance and durability.

Alternative Fuels II

Synthetic Fuels: Introduction to Syngas, DME, P-Series, GTL, BTL, study of production, advantages, disadvantages, need, types, properties, storage and handling, dispensing and safety, discussion on air and water vehicles.

Emission Control (SI Engine)

Emission formation in S.I. engines - Hydrocarbons, carbon monoxide, oxides of nitrogen, poly-nuclear aromatic hydrocarbon, effects of design and operating variables on emission formation in spark ignition engines, controlling of pollutant formation in engines exhaust after treatment, charcoal canister control for evaporative emission control, emissions and drivability, positive crank case ventilation system for UBHC emission reduction.

Emission Measurement and Control (CI Engine)

Chemical delay, intermediate compound formation, pollutant formation on incomplete combustion, effect of design and operating variables on pollutant formation, controlling of emissions, emissions and drivability, exhaust gas recirculation, exhaust after treatment– DOC, DPF, SCR and LNT measurement and test procedure (NDIR analyzers, FID, chemiluminescence NOx analyzer, oxygen analyzer, smoke measurement, constant volume sampling, particulate emission measurement, Orsat apparatus.).

Health effects of Emissions from Automobiles

Emission effects on health and environment. Emission inventory, ambient air quality monitoring, Emission Norms: As per Bharat Standard up to BS – VI

Books

1. Thipse S.S., Alternative Fuels, Jaico Publications.

2. Pundir B.P., Engine Emission, Narosa Publication.

3. Ganesan V., Internal Combustion Engines, Tata McGraw Hill.

4. Crouse W.M. and Anglin A.L, Automotive Emission Control, McGraw Hill.

5. Thipse S.S., IC Engines, Jaico Publications.

6. Springer G.S. and Patterson D.J., Engine Emissions, Pollutant Formation, Plenum Press.

7. ARAI Vehicle Emission Test Manual.

PE AUE 711 B: CAD/CAM and Modern Manufacturing Methods

Subject Code : PE – AUE 711B
Category : Professional Elective Courses
Subject Name : CAD/CAM and Modern Manufacturing Methods
Semester : Seventh
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech. (AUE).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcomes

Students will be able to:

CO1	Identify proper computer graphics techniques for geometric modelling.
CO2	Transform, manipulate objects and store and manage data.
CO3	Prepare part programming applicable to CNC machines.
CO4	Analyze rapid prototyping and tooling concepts in any real-life applications.
CO5	Define the tools for Analysis of a complex engineering component.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	2	-	2	-	-	1	-	-	3
CO 2	3	3	-	2	-	-	-	2	-	-	-	2
CO 3	3	3	-	2	1	-	-	-	2	-	-	3
CO 4	3	2	1	-	2	2	-	2	-	-	3	2
CO 5	2	3	2	2	-	-	-	2	2	1	2	2

Syllabus (PE AUE 711 B)

Computer Graphics and Techniques for Geometric Modeling

Computer Graphics: Two-dimensional computer graphics, Computer Graphics: concept of rasterisation, linear interpolation algorithms (DDA and Bressenham), different geometrical transformations, The parametric representation of geometry, Bezier curves, Cubic Spline curve, B-Spline curve, parametric representation of line, circle, ellipse & parabola. Constructive solid geometry (CSG), Boundary Representation (B-Rep), Wire Frame Modeling, Solid Modeling, Surface Modeling, Parametric Modeling, feature based modeling, Feature recognition, Design by feature, Artificial Intelligence in Design & Manufacturing.

NC & CNC Technology

Tape coding & format, Manual Part Programming, Computer Aided Part Programming, CNC functions & advantages, DNC, adaptive Control, CNC programming concepts, Trends & new developments in NC, Part programmers' job, functions of a post processor, NC part programming languages, Elements of a APT language, The Macro Statement in APT, NC programming with interactive graphics. Constructional details of CNC machines, Feedback devices- Velocity & displacement, Machining Centers and its types, Automated Material Handling & storage Systems like Robots, AGVs and AS/RS etc.

Computer Integrated Manufacturing & Technology Driven Practices

Introduction, Evolution, Objectives, CIM Hardware and Software, CIM Benefits, Nature and role of the elements of CIM, Identifying CIM needs, Data base requirements of CIM, Role of CAD/CAM in CIM, Obstacles to Computer Integrated Manufacturing, Concept of the future CIM systems, Socio -techno- economic aspects of CIM.

Rapid Prototyping and Tooling

Introduction to RP, Technology Description, Overview of RP, Benefits and Application. RP Processes: Process overviews, STL file Generation, Classes of RP systems: Stereo-lithography Approach (SLA), SLA with liquid thermal polymerization, Selective Laser Sintering (SLS), Fused deposition modelling, Laminated object manufacturing, Laser powder forming. Prototype properties, RP Applications: Design, Concept Models, Form & fit checking, Functional testing, CAD data verification, Rapid Tooling, Rapid manufacturing, RP processes for MEMS, Photolithography.

Books

1. Groover M.P. and Zimmers, Jr.E.W., CAD/CAM Computer Aided and Manufacturing, Eastern Economy Edition.

2. Zeid I. and Sivasubramanian R., CAD/CAM, Theory & Practice, McGraw Hill Publication.

3. Radhakrishan P., Subramanyan S. and Raju V., CAD/CAM/CIM, New Age International Publisher.

4. Rao P.N., CAD/CAM Principles and Applications, McGraw Hill Publication.

5. Pabla B.S. and Adithan M., CNC Machines, New Age International Publisher.

6. Kundra T.K., Rao P.N. and Tiwari N.K., Numerical Control and Computer Aided Manufacturing, McGraw Hill.

7. Groover M.P., Automation, Production Systems and Computer Integrated Manufacturing, Prentice-Hall of India Pvt. Ltd.

8. Noorani R., Rapid Prototyping: Principles and Applications, Wiley.

Department of Automobile Engineering

PE AUE 712 A: Automotive Component and System Design

Subject Code : PE – AUE 712 A
Category : Professional Elective Courses
Subject Name : Automotive Component and System Design
Semester : Seventh
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech. (AUE).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcomes

Students will be able to:

CO1	Understand the constructional details of various principal parts of IC Engines, transmission system components, brake system, suspension system and power transmitting drive trains.
CO2	calculate the amount of torque transmitted through different clutches during the engagement of clutch, gear ratio during different gear positions from 1st gear to top gear, amount of braking force acting on the brake line, amount of load acting on each suspension springs.
CO3	Apply the fundamental knowledge of applied mechanics and material strength to solve the actual design problem.
CO4	Design the principal parts of IC Engines, clutches and gear boxes, propeller shaft, final drive, universal joint, leaf spring, coil spring and differential.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	-	2	1	-	-	-	-	2
CO 2	3	2	2	2	2	1	-	-	2	-	-	2
CO 3	3	3	3	3	2	3	3	2	2	2	2	3
CO 4	3	3	3	3	3	2	3	3	2	3	3	3

Syllabus (PE AUE 711 B)

Design of following principal parts of I.C. Engines

Cylinder and cylinder liner- Material Selection, Design of cylinder, Piston, piston rings and piston pin or gudgeon pin- Material Selection. Design considerations, Design calculations of Connecting rod with small and big end bearing-forces acting on it. Design of Crank, crankshaft and crank pin, Cam shaft and Valve Operating mechanism.

Design of Clutches and Gear Boxes

Single plate, multiple plates, centrifugal clutch, lining material, lever design, sliding mesh, constant mesh, synchromesh gear box, gear ratio and gear shifting lever, sliding mechanism.

Design of Drive train

Design of propeller shaft and U-joints, Design of propeller shaft, criteria, failure theories-joint design, Design of Final drive and differential.

Brakes and Suspension

Internal expanding shoe brake, friction lining material, leaf spring, coil spring, materials, suspension system and linkages, independent suspension.

Advanced automotive Body Structures

Emphasis is on body concept for design. Material selection and manufacturing constraints.

Books

1. Ramamurhti V., Computer Aided Mechanical Design and Analysis, 3rd Ed., TMH.

2. Burr A.H. and Cheatham J.B., Mechanical Analysis and Design, 2nd Ed., PHI, 1995.

3. Shigley J.E., Mechanical Engineering Design, McGraw Hill, 2003.

4. Schmid, S.R., Hamrock B.J. and Jacobson B.O., Fundamentals of Machine Elements, McGraw Hill, 1993.

5. Bhandari V.B., Design of Machine Elements, McGraw Hill Pub.

Department of Automobile Engineering

PE AUE 712B: Two & Three Wheelers

Subject Code : PE – AUE 712 B
Category : Professional Elective Courses
Subject Name : Two and Three Wheelers
Semester : Seventh
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech. (AUE).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcomes

Students Will be able to:

CO1	Understand the various types of Two & Three Wheelers along with their development history.
CO2	Describe the constructional features of 2 stroke & 4 stroke engine, engine cooling & lubrication techniques, various types of required systems for running the engine smoothly and chassis systems.
CO3	Elaborate the constructional features, their working principles and functions of the suspension system, steering handlebar, brake system, wheel & tyre, Electrical system.
CO4	Analyse the various kinds of maintenance procedure of two & three wheelers.
CO5	Design the chassis subsystems which can rectify the various issues generated previously by the users and gives the new concept of power transmission and control system.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	2	-	-	-	-	-	-	-	2
CO 2	3	-	-	-	-	-	2	2	-	-	-	2
CO 3	3	-	3	2	2	2	3	2	2	-	2	2
CO 4	3	3	-	3	3	3	3	3	2	3	2	3
CO 5	3	2	3	3	2	3	-	2	2	3	3	3

Department of Automobile Engineering

Syllabus (PE AUE 712 B)

Introduction

Development, history, Classification & layouts of two & three-wheeler vehicles.

Systems requirements for Engine lubrication, cooling & engine starting

Fuels used Valve timing and port timing diagram, scavenging, types of scavenging and relative merits and demerits with one another.

Chassis & Sub Systems, Chain and shaft drive, Clutch, CVT-Continuously Variable Transmission, gear box– construction and working principle - gear controls & shifting mechanism.

Suspension & Steering Handle bar, Instrumentation & Controls

Two-wheeler / three-wheeler panel meters & controls. All types Switches, Indicators, warnings indicators / buzzers & actuating levers on steering handle bar. Starting / Ignition and steering lock key switch on Steering Handle Shaft.

Brakes and Wheels

Brake types, Brake circuit Layout for two-wheeler and three-wheeler vehicles. Wheels - Front and Rear – Wheel rim types, Tyre – functions – materials, methods vulcanizing of Tubes & Tyres for Tubeless tyres.

Two & three-wheeler Maintenance

Importance of maintenance – general maintenance, scheduled maintenance, Servicing of two-wheeler vehicles, periodic check-ups.

Electrical Systems & Instruments

Battery specifications, Charging system, Lighting (front & rear), Ignition key switch, Horn, Side Signalling, Instruments & Indicators.

Helmets

Types & purpose. Safety standards related to helmets.

Books

1. Steed N., The Motor Vehicle, McGraw Hill Book Co. Ltd., New Delhi.

2. Herrmann S., The Motor Vehicle, Asia Publishing House, Bombay.

3. Two stroke Motor Cycles, Staff & Motor Cycles, London llefe Books.

4. Narang G.B.S., Automobile Engineering, Khanna Publishers, New Delhi.

5. Panchal D.U., Two and Three-Wheeler Technology, PHI Learning Pvt. Ltd., New Delhi.

6. Service Manuals of Manufacturers of Indian Two & Three wheelers.

7. Service Manual, Jeep Utility Vehicles, Villys Motors, Ioc., USA.

OE AUE 711A: Quality Control & Reliability Engineering

Subject Code : OE – AUE 711 A
Category : Professional Elective Courses
Subject Name : Quality Control & Reliability Engineering
Semester : Seventh
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech. (AUE).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam)

Course Outcomes

Students will be able to:

CO1	Express the knowledge about various concepts of descriptive statistics like mean, mode, median, standard deviation, standard deviation etc and learn their application.
CO2	Apply and use different tools and techniques used in quality control engineering.
CO3	Develop a basic understanding of concepts of reliability engineering along with use of statistical and design model in reliability engineering.
CO4	Analyze different types of sampling methods used in control engineering.
CO5	Analyze different types of failures and apply techniques to overcome these failures in reliability engineering.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2	2	1	1	2	1	-	-	-	2
CO 2	3	-	2	-	-	-	2	2	-	-	-	2
CO 3	3	-	2	2	2	2	3	2	2	-	2	1
CO 4	3	2	-	3	2	3	3	3	1	3	2	3
CO 5	3	2	1	2	2	3	-	1	2	3	2	3

Syllabus (OE AUE 711 A)

Basics of quality

Quality objectives, Quality control, Quality Assurance, Quality costs, Quality loss function, Statistical tolerance, quality assurance statistical tools used in quality in SQC, Quality planning, Organization for quality. Bureau of Indian standards, ISO 9000: 2008-quality circles KAIZEN-TQM concepts-Quality audit.

Statistical Process Control

Variation in processes, Factors, Process capability, Analysis of process capability, control charts, variables, Attributes, Establishing and interpreting control charts, X,R, chart for variables, defects, P chart, C-chart and U chart-Con-troll charts for defective quality rating.

Acceptance Sampling

Lot-by-lot sampling, types probability of acceptance in single double, multiple sampling techniques- O.C. curves, procedure's Risk and consumers Risk AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

Life Testing-Reliability-Systems Approach

Life testing-objectives-classification-failure characteristics-failure data analysis-mean time to failure-maintainability and availability-reliability-system reliability-series and parallel systems-systems reliability in terms of probability of failure-MTBF-Acceptance sampling based on reliability test OC curves.

Quality and Reliability

Reliability improvement- techniques, use of Pareto analysis- Design for reliability, Redundancy, standby redundancy, failsafe systems- optimization in reliability, product design, product analysis, product development product cycle.

Quality function deployment

FMEA, Quality circles, ISO 9000 series and 14000 series, 3 Sigma and 6 Sigma concepts.

Books

Learning Resources

1. Betsterfield D.H., Quality Control, Revised Edition, Prentice Hall Pub, 1993.

2. Montgomery D.C., Statistical Quality Control: A Modern Introduction, 6th Ed., Wiley India.

3. Sharma S.C., Inspection Quality Control and Reliability, Khanna Publishers, New Delhi 1998.

4. Bank J., The Essence of Total Quality Management, Prentice Hall of India Pvt. Ltd., New Delhi, 1995.

5. Samson D., Manufacturing & Operations Strategy, Prentice Hall, New York, 1991.

6. Ganapathy K., Narayana V. and Subramaniam B., Quality Circle Concepts and Implementation, QCFI, Secondrabad.

7. Bagchi T.P., ISO9000 Concepts Methods and Implementation, Wheeler Publisher Allahabad, 1994.

8. Ross P.J., Taguchi Techniques for Quality Engineering, McGraw Hill, New York, 1998.

OE AUE 711B: Machine Learning

Subject Code : OE – AUE 711 A
Category : Professional Elective Courses
Subject Name : Quality Control & Reliability Engineering
Semester : Seventh
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech. (AUE).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam)

Course Outcomes

Students will be able to:

CO1	To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
CO2	To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
CO3	Explore supervised and unsupervised learning paradigms of machine learning.
CO4	To explore Deep learning technique and various feature extraction strategies

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	3	2	2	2	2	1	3
CO 2	3	3	3	-	1	3	-	2	2	2	2	3
CO 3	3	3	2	2	1	3	2	3	2	2	2	3
CO 4	3	3	3	1	1	3	2	3	2	2	3	3

Syllabus (OE AUE 711 B)

Introduction

Learning– Types of Machine Learning– Supervised Learning– The Brain and the Neuron– Design a Learning System– Perspectives and Issues in Machine Learning – Concept Learning Task– Concept Learning as Search– Finding a Maximally Specific Hypothesis– Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants– Perceptron– Linear Separability– Linear Regression.

Linear Models

Multi-layer Perceptron– Going Forwards– Going Backwards: Back Propagation Error– Multilayer Perceptron in Practice– Examples of using the MLP– Overview– Deriving Back Propagation – Radial Basis Functions and Splines– Concepts– RBF Network– Curse of Dimensionality– Interpolations and Basis Functions– Support Vector Machines

Tree and Probabilistic Models

Learning with Trees– Decision Trees– Constructing Decision Trees– Classification and Regression Trees– Ensemble Learning– Boosting– Bagging– Different ways to Combine Classifiers– Probability and Learning– Data into Probabilities– Basic Statistics– Gaussian Mixture Models– Nearest Neighbour Methods– Unsupervised Learning– K means Algorithms– Vector Quantization– Self Organizing Feature Map. Acceptance Sampling

Dimensionality Reduction and Evolutionary Models

Dimensionality Reduction– Linear Discriminant Analysis– Principal Component Analysis– Factor Analysis– Independent Component Analysis– Locally Linear Embedding– Isomap– Least Squares Optimization– Evolutionary Learning– Genetic algorithms– Genetic Offspring: Genetic Operators– Using Genetic Algorithms– Reinforcement Learning– Overview– Getting Lost Example– Markov Decision Process.

Graphical Models

Markov Chain Monte Carlo Methods– Sampling– Proposal Distribution– Markov Chain Monte Carlo– Graphical Models– Bayesian Networks– Markov Random Fields– Hidden Markov Models– Tracking Methods.

Books

Learning Resources

1. Marsland S., Machine Learning– An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

2. Mitchell T.M., Machine Learning, First Edition, McGraw Hill Education, 2013.

3. Flach P., Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.

4. Bell J., Machine learning- Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014.

5. Alpaydin E., Introduction to Machine Learning, 3rd Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014.

6. Dr. Jeeva Jose, Introduction to Machine Learning, Khanna Publishing House, 2019.

OE 711C: Cloud Computing

Subject Code : OE – AUE 711 C
Category : Professional Elective Courses
Subject Name : Cloud Computing
Semester : Seventh
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech. (AUE).
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam)

Course Outcomes

Students will be able to:

CO1	Identify the appropriate deployment models, service models and basic cloud architecture
CO2	Explain the concept of abstraction and different aspects of virtualization technology
CO3	Understand the importance of protocols and standards in management for cloud and Identify security implications in cloud computing
CO4	Analyse different services and applications in Cloud Computing

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	2	-	2	3	2	-	2	2
CO 2	1	2	-	-	3	3	2	3	2	2	-	2
CO 3	2	1	2	3	3	3	2	3	2	2	3	2
CO 4	2	1	2	2	2		2	3	2		3	3

Syllabus (OE AUE 711 C)

Introduction

Introduction - Historical Development - Cloud Computing Architecture – The Cloud Reference Model – Cloud Characteristics – Cloud Deployment Models: Public, Private, Community, Hybrid Clouds - Cloud Delivery Models: IaaS, PaaS, SaaS – Open-Source Private Cloud Software: Eucalyptus, Open Nebula, Open Stack.

Virtualization

Data Center Technology - Virtualization - Characteristics of Virtualized Environments – Taxonomy of Virtualization Techniques – Virtualization and Cloud Computing – Pros and Cons of Virtualization - Implementation Levels of Virtualization - Tools and Mechanisms: Xen, VMWare, Microsoft Hyper-V.

Cloud Computing Mechanism

Cloud Infrastructure Mechanism: Cloud Storage, Cloud Usage Monitor, Resource Replication – Specialized Cloud Mechanism: Load Balancer, SLA Monitor, Pay-per-use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi Device Broker, State Management Database – Cloud

Management Mechanism

Remote Administration System, Resource Management System, SLA Management System, Billing Management System.

Hadoop and Map Reduce

Apache Hadoop – Hadoop Map Reduce – Hadoop Distributed File System- Hadoop I/O Developing a Map Reduce Application - Map Reduce Types and Formats - Map Reduce Features – Hadoop Cluster Setup – Administering Hadoop. Security in the Cloud: Basic Terms and Concepts – Threat Agents – Cloud Security Threats – Cloud

Security Mechanism

Encryption, Hashing, Digital Signature, Public Key Infrastructure, Identity and Access Management, Single Sign-on, Cloud Based Security Groups, Hardened Virtual Server Images.

Books

1. Thomas E., Mahood Z. and Puttini R., Cloud Computing, Concept, Technology and Architecture, Prentice Hall, 2013.

2. Velte T., Velte A. and Elsenpeter R.C., Cloud Computing- A Practical Approach, Tata McGraw-Hill Edition, 2010.

3. Buyya R., Vecchiola C. and Selvi S.T., Mastering Cloud Computing, Tata McGraw-Hill, 2013.

4. Bahga A. and Madisetti V., Cloud Computing: A Hands-On Approach, Universities Press, 2014.

5. White T., Hadoop: The Definitive Guide, 4th Edition, O'Reilly Media, 2015.

6. Smith J.E. and Nair R., Virtual Machines, Elsevier, 2005.

7. Rittinghouse J. and Ransome J., Cloud Computing, Implementation, Management and Strategy, CRC Press, 2010.

Department of Automobile Engineering

HM HU 701: Economics for Engineers

Course Code : HM HU 701
Course Title : ECONOMICS FOR ENGINEERS
L-T-P : 3-0-0
Category : Basic Science Courses
Semester : Seventh
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Make different economic decisions and estimate engineering costs by applying different cost estimation models.
CO 2	Create cash flow diagrams for different situations and use different interest formulae to solve associated problems. Take decisions regarding different engineering projects by using various criteria like rate of return analysis, present worth analysis, cost-benefit analysis etc.
CO 3	Incorporate the effect of uncertainty in economic analysis by using various concepts like expected value, estimates and simulation
CO 4	Understand the concepts of depreciation, replacement analysis, scope of Finance and the role of financial planning and management, the process of inflation and use different price

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	2	-	-	-	2	-	2	2	2	2	3
CO2	1	-	3	-	2	-	-	2	-	-	3	2
CO3	1	-	-	2	-	-	-	2	2	2	2	3
CO4	1	2	-	-	2	2	1	-	-	-	3	2

Syllabus: HM HU 701

UNIT 1

Economic Decisions Making – Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring and Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types of Estimates, Estimating Models – Per Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.

UNIT 2

Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal& Effective Interest. Cash Flow & Rate of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing an Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity and Breakeven Analysis. Economic Analysis in The Public Sector -Quantifying and Valuing Benefits & drawbacks.

UNIT-3

Inflation and Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Indices, Composite vs Commodity Indexes, Use of Price Indexes in Engineering Economic Analysis, Cash Flows that inflate at different Rates. Present Worth Analysis: End-Of-Year Convention, Viewpoint of Economic Analysis Studies, Borrowed Money Viewpoint, Effect of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. Uncertainty in Future Events - Estimates and Their Use in Economic Analysis, Range of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options**.**

UNIT-4

Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation and Expenses, Types of Property, Depreciation Calculation Fundamentals, Depreciation and Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements of Tax Regulations for Depreciation and Capital Allowances. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.

Books

Learning Resources:

1. Engineering Economy, Sullivan and Wicks, Koelling, Pearson

2. Engineering Economics, R.Paneer Seelvan, PHI

3. Engineering Economics Analysis, Michael R Lindeburg,, Professional Pub

PC AUE 791: Automobile Engineering Lab -V (Automobile Electrical & Electronics Lab)

Course Code : PC AUE 791
Course Title : Automobile Engineering Lab-V (Automobile Electrical & Electronics Lab)
L-T-P : 0-0-3
Category : Basic Science Courses
Semester : Seventh
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (40 for Continuous Evaluation; 60 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	To understand the basics of Microprocessor Interfacing in practical applications.
CO 2	To learn rectifiers, filters, A/D and D/A convertors.
CO 3	Explain different kinds of automotive wiring
CO 4	Analyse the action of basic electric circuits

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	2	-	-	-	2	-	2	2	2	2	3
CO2	1	-	3	-	2	-	-	2	-	-	3	2
CO3	1	-	-	2	-	-	-	2	2	2	2	3
CO4	1	2	-	-	2	2	1	-	-	-	3	2

Syllabus: PC AUE 791

Automotive Electronics Part

1. Characteristics of rectifier.
2. Study of IC timer.
3. Study of Microprocessor 8085.
4. Simple ALP program using 8085 MEL Kit.
5. Data acquisition from sensors using 8085 MEL Kit.
6. Interfacing of stepper motor with 8085 MEL Kit.
7. Fault finding location of sensor in car using OBDS.

Automotive Electrical Syllabus

1. Battery testing
2. Alternator testing.
3. Starter motor testing.
4. Diagnosis of ignition system.
5. Diagnosis of automotive electrical wiring.
6. Fault finding of relay & fuses in car using Off Board Diagnostics Systems (OBDS).
7. Relay & fuse Fault diagnostic of a car using OBDS.

Department of Automobile Engineering

PW – AUE 781: Project III

Course Code : PW AUE 781
Course Title : Project-III
L-T-P : 0-0-6
Category : Project
Semester : Seventh
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (100 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO 1	Get Exposure to research and development.
CO 2	Generate and implement innovative ideas for social benefit.
CO 3	Develop Algorithms/Programs/Prototype/Models.
CO 4	Solve the industrial problems at various stages.

CO-PO Mapping

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	2	3	3	3	2	2	1	3	2	2	1
CO2	3	1	2	2	3	3	3	3	2	2	2	3
CO3	3	2	3	3	3	3	3	2	3	3	2	2
CO4	3	2	2	3	3	2	2	1	3	3	3	2

Department of Automobile Engineering

8th Semester

PE – AUE 811A: Off Road Vehicles

Subject Code : PE – AUE 811A
Category : Professional Elective Courses
Subject Name : Off Road Vehicles
Semester : Eighth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students Will be able to:

CO1	Understand the various types, constructional features, working principles, design methodology of off-road vehicles and their applications.
CO2	Identify the various kind of systems off-road vehicles such as earth moving equipment and agricultural equipment.
CO3	Calculate the production capacity and cost of production of shovels, draglines and dumpers and also design & fabricate the hydraulic & pneumatic circuits.
CO4	Perform the maintenance process of various off-road vehicles such as earth moving equipment and agricultural equipment.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	1	1	-	2	2	-	-	-	-	3
CO 2	3	-	-	-	-	3	3	2	-	-	-	2
CO 3	3	3	-	2	3	2	2	-	2	2	2	3
CO 4	3	3	2	2	3	2	2	-	2	2	-	2

Syllabus (PE AUE 811 A)

Introduction

Classification of off-road vehicles and their applications.

Shovels

Types of shovels, Construction details of diesel, electric and hydraulic shovel. Operating principles and operating cycle. Production capacity and cost of production.

Draglines

Types of Dragline, Construction and Operating cycle, Production capacity and cost of production.

Dumpers

Types of Dumpers. Construction and Operating cycle, Carrying capacity, matching with Shovel capacity and cost of production.

Dozer and Grader

Different types of Dozer, construction and operation, dozer capacity, grader and its construction, application of dozer and grader.

Tractor and Tractor Units

Tractors in Earth Moving, Application of Tractors, Rating of Tractors, Wheel and Crawler Tractor, Recent Trend in Tractor Design, Power shift Transmission and Final drive in Caterpillar Tractor, Control Mechanism of a Caterpillar.

Fork Lift Truck and Road Roller

Types, layout and lifting mechanism of Fork Lift Truck, construction and working Principle of Fork Lift truck, Types, layout, operation & maintenance of Road Roller.

Books

1. Abrosimov K., Branberg A. and Katayer K., Road Making Machinery, MIR Publishers, Moscow, 1971.

2. De, A., Latest Development of Heavy Earth Moving Machinery, Annapurna Publishers, Dhanbad, 1995.

3. Nichols H.L.Jr., Moving the Earth, Galgotia Publishing House, New Delhi, 1962.

4. Rudnev V.K., Digging of Soils by Earthmover with Power Parts, Oxanian Press Pvt. Ltd., New Delhi, 1985.

PE – AUE 811B: Automotive Air Conditioning

Subject Code : PE – AUE 811B
Category : Professional Elective Courses
Subject Name : Automotive Air Conditioning
Semester : Eighth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students Will be able to:

CO1	Identify various components of Vehicle Air conditioning and heating system
CO2	Operate manually and automatic Air conditioning and heating system
CO3	Apply various concepts related to Air conditioning and heating system
CO4	Diagnose various faults in air conditioning system by using suitable tools and instruments and follow safety rules while servicing of Air conditioning and heating system.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	2	2	-	-	-	-	-	-	3
CO 2	3	3	2	3	-	-	-	2	2	2	-	2
CO 3	3	2	2	2	2	2	-	-	-	-	2	3
CO 4	3	3	2	2	2	3	2	2	2	2	-	2

Syllabus (PE AUE 811 B)

Introduction of Air-conditioning System

Simple vapour compression refrigeration system (V.C.R.S), Driers, Lubricants, Refrigeration components and controls: components, condenser, evaporators, valves electrical circuits and devices, etc.

Refrigerants

Refrigerants and their properties.

Psychometrics

Human comfort, Psychometric properties and processes, sensible and latent heat loads, characterization and SHF load for ventilation and filtration, concepts of SHF and ESHF and ADP, concepts of human comfort and effective temperature.

Air-conditioning equipment

Components and controls, Installation of Air conditioning system in vehicle**.**

Load estimation

Heat transfer from exterior wall, passenger, Equipment and infiltrated air. Heater system for winter conditioning, Requirement of air and air distribution systems, duct design, duct systems. Maintenance and repair: Air-conditioning system.

Books

1. Stoecker W.F. and Jones J.W., Refrigeration & Air-conditioning, McGraw Hill Publishing Company Limited, 1982.

2. Lung P., Automotive Air Conditioning, C.B.S. Publisher & Distributor, New Delhi.

3. Giri N.K., Automotive Technology, Khanna Publishers, 2004.

4. De A., Automobile Engineering, Galgotia Publishing House, 2004.

5. Babu A.K., Automobile Mechanics, Khanna Publishing House, 2019.

Department of Automobile Engineering

PE – AUE 812A: Non-Destructive Testing Methods

Subject Code : PE – AUE 812A
Category : Professional Elective Courses
Subject Name : Non-Destructive Testing Methods
Semester : Eighth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students Will be able to:

CO1	Understand the various types of Destructive & Non-destructive techniques and their comparison.
CO2	Explain the working principles, applications of different type of Non-destructive testing methods and elaborate the designing methodology.
CO3	Analyse the various kinds of Non-Destructive Testing methods for the perfect selection during the testing & Comparison with the others.
CO4	Evaluate the various types of defect analysis, norms and case studies.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	2	3	3	2	-	-	-	2
CO 2	3	-	-	-	-	2	2	-	3	-	-	2
CO 3	3	3	-	-	3	2	2	2	2	3	3	3
CO 4	3	-	3	2	2	2	-	-	2	2	3	3

Syllabus (PE AUE 812 A)

Visual/Optical Examination: Principal, Procedure, Instrument, Applications.

Principle, Procedure and Applications of Liquid Penetrating technique, Magnetic Particle Testing, Eddy Current Testing, Ultrasonic Testing, Radiography, Thermography and Acoustic emission testing

Comparison and Selection of NDT Methods: Inspection of Raw materials, Inspection of Secondary Processing, In-service Damage Inspection.

Common Application of NDT: a) Characterization of materials, b) Defect analysis, c) Case study. Codes Standards, Specifications and Procedures.

Books

1. Mcgomnagle W.J., Non-Destructive Testing, McGraw Hill.

2. Raj B., Jayakumar T. and Thavasimuthu M., Practical Non-Destructive Testing, Narosa Publishing House, 2009.

3. ASM Metals Handbook, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA.

PE – AUE 812B: Noise, Vibrations and Harshness

Subject Code : PE – AUE 812A
Category : Professional Elective Courses
Subject Name : Noise, Vibrations and Harshness
Semester : Eighth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Identify vibrations and noise coming out of automobiles.
CO2	Apply vibration control models and methodologies to reduce the vibrations, noise of Automobiles.
CO3	Analyse the fundamentals of acoustics in Automotives.
CO4	Investigate level of harm caused by noise and harshness and to provide measures to control it

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	-	2	2	2	-	-	-	2
CO 2	2	3	3	3	3	3	2	-	2	2	2	2
CO 3	3	3	2	2	-	-	-	2	-	-	-	2
CO 4	2	2	3	2	-	2	2	2	2	2	2	3

Syllabus (PE AUE 812 A)

Basics of Vibrations

Basic Concepts, Mathematical Models, System characteristics and response, Single and Multi DOF systems.

Vibration control

Isolators, Tuned absorbers, Untuned viscous dampers, Applications: single cylinder engines, multi cylinder engine, Simple rubber engine mounts, Hydro elastic mounts, Semi-active mounts and active mounts, Mass elastic models and measurements, Limits for passenger comforts.

Sound & sound measurement

Fundamentals of acoustics, General sound propagation, Plane wave propagation, Spherical wave propagation, Human response to sound– the audible range, Sound measurement, Instrumentation, Sound level meters, Frequency intensity analysers, Real time measurements.

Automotive noise

Automotive noise criteria, Drive by noise test, Noise from stationary vehicles, Interior noise in vehicles, Automotive noise, Sources and control methods: Engine noise, Transmission noise, Intake and exhaust noise, Aerodynamic noise, Tyre noise, Brake noise.

General noise control principles

Sound in enclosures, Sound energy absorption, Sound transmission through barriers.

Harshness

Causes, Frequency limits.

Books

Learning Resources

1. Rao S.S., Mechanical Vibrations, Addison Wesley Longman, New Delhi, 1995.
2. Heinz H., Advanced Engine Technology, SAE, 1995.
3. SAE, Automobiles and Pollution, SAE Transaction, 1995.
4. Seto, Mechanical Vibrations, Schaum Outline Series, McGraw Hill Book Company, New York, 1990.
5. Springer and Patterson, Engine Emission, Plenum Press, 1990.
6. Thomson W.T., Theory of Vibration with Applications, CBS Publishers and Distributors, New Delhi, 1990.
7. Mallik A.K., Principles of Vibration Control, Affiliated East-West Press (P) Ltd., New Delhi, 1990.
8. Grover G.K., Mechanical Vibrations, New Chand and Brothers, Roorkey, 1989.
9. Morse T. and Hinkle, Mechanical Vibration, Prentice Hall of India Ltd., New Delhi, 1987.

PE – AUE 811C: Finite Element Method & Its Applications

Subject Code : PE – AUE 812C
Category : Professional Elective Courses
Subject Name : Finite Element Method & it's applications
Semester : Eighth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students Will be able to:

CO1	Understand the fundamentals of various mathematical models used in Automobile Engineering.
CO2	Apply FEM formulation techniques for simple structures used in Automotives.
CO3	Analyse 1-D and 2-D variational equations in structural members of Automotive Components during external load application.
CO4	Create models using the FE Software for the solution of Dynamic Problems.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3	3	3	3	-	1	-	1	-	-	3
CO 2	3	2	2	2	3	2	1	-	2	-	-	2
CO 3	2	3	3	2	3	-	1	-	-	-	-	3
CO 4	3	2	3	2	3	2	-	2	-	2	2	2

Syllabus (PE AUE 812 A)

Module 1

Historical Background, Mathematical modelling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

Module 2

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

Module 3

Two dimensional equations, variational formulation, finite element formulation, triangular elements shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

Module 4

Natural coordinate systems, iso-parametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software.

Books

1. Reddy J.N., An Introduction to Finite Element Method, 3rd Ed., McGraw Hill, 2005.
2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.
3. Rao S.S., The Finite Element Method in Engineering, 3rd Ed., Butterworth Heinemann, 2004.
4. Chandraputla & Belegundu, Introduction to Finite Elements in Engineering, 3rd Ed., Prentice Hall, 1990.

OE – AUE 811A: Tribology

Subject Code : OE – AUE 811A
Category : Professional Elective Courses
Subject Name : Tribology
Semester : Eighth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students Will be able to:

CO1	Understand the fundamentals of various types of Lubricants and their properties.
CO2	Apply the concepts of friction and wear mechanism valid for Automotive Systems.
CO3	Analyse the various kinds of lubrication technologies to use them for Automotive Systems.
CO4	Design Automotive Lubrication Systems practically using the idea of Industrial Tribology.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	-	-	-	-	-	-	-	-	2
CO 2	3	2	2	2	-	-	-	-	-	-	-	2
CO 3	3	3	2	2	2	2	2	-	-	-	-	3
CO 4	3	2	2	2	3	2	2	2	2	2	2	3

Syllabus (OE AUE 811 A)

Introduction to Tribology

Introduction to Tribology, Tribology in design, Tribology in industry, economic aspects of Tribology, lubrication, basic modes of lubrication, lubricants, properties of lubricants-physical and chemical, types of additives, extreme pressure lubricants, recycling of used oils and oil conservation, disposal of scrap oil, oil emulsion. Types of sliding contact bearings, comparison of sliding and rolling contact bearings.

Friction and Wear

Friction: Introduction, laws of friction, kinds of friction, causes of friction, friction measurement, theories of friction, effect of surface preparation.

Wear: Types of wear, various factors affecting wear, measurement of wear, wear between solids and liquids, theories of wear.

Hydrodynamic lubrication

Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, two-dimensional Reynold's equation, infinitely long journal bearing, infinitely short journal bearing, finite bearing. Hydrodynamic thrust bearing: Introduction, flat plate thrust bearing, pressure equation, load, centre of pressure, friction in tilting pad thrust bearing.

Hydrostatic Lubrication

Hydrostatic lubrication: Basic concept, advantages and limitations, viscous flow through rectangular slot, load carrying capacity and flow requirement of hydrostatic step bearing, energy losses, optimum design of step bearing. Compensators and their actions. Squeeze film lubrication: Introduction, circular and rectangular plates approaching a plane.

Elasto-hydrodynamic Lubrication and Gas Lubrication

Elasto-hydrodynamic Lubrication: Principle and application, pressure-viscosity term in Reynolds equation, Hertz theory. Ertel-Grubin Equation.

Gas lubrication: Introduction, merits and demerits, applications. Lubrication in metal working: Rolling, forging, drawing extrusion. Bearing materials, bearing constructions, oil seals, shields and gaskets.

Surface Engineering

Introduction to surface engineering, concept and scope of surface engineering, manufacturing of surface layers, solid surface geometrical, mechanical and physic chemical concepts, superficial -layer, development of concept, structure of superficial layer, general characteristics of superficial layer, obtained by machining, strengthening and weakening of superficial layer.

Books

Learning Resources

1. Cameron A., Basic Lubrication Theory, Wiley Eastern Ltd.

2. Wen S., Principles of Tribology, Wiley.

3. Majumdar B.C., Introduction to Tribology and Bearings, S. Chand and Company Ltd., New Delhi.

4. Fuller D.D., Theory and Practice of Lubrication for Engineers, John Wiley and Sons.

5. Halling J., Principles of Tribology, McMillan Press Ltd.

6. Bhushan B. and Gupta B.K., Handbook of Tribology: Materials, Coatings and Surface Treatments, McGraw-Hill.

7. Davis J., Surface Engineering for Corrosion and Wear Resistance, Woodhead Publishing, 2001.

8. Burakowski T., Surface Engineering of Metals: Principles, Equipments, Technologies, Taylor and Francis.

OE – AUE 811B: Internet of Things

Subject Code : OE – AUE 811B
Category : Professional Elective Courses
Subject Name : Non-Destructive Testing Methods
Semester : Eighth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students Will be able to:

CO1	Understand the concepts of Internet of Things.
CO2	Implement basic IoT applications on embedded platform.
CO3	Analyse basic protocols in wireless sensor network.
CO4	Design IoT applications in different domains for specific performance.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	-	-	2	-	-	-	-	-	-	2
CO 2	3	2	2	2	3	2	2	2	2	2	2	3
CO 3	3	3	2	2	3	-	-	-	-	-	-	2
CO 4	3	2	3	3	3	3	2	2	2	2	2	3

Syllabus (OE AUE 811 B)

Introduction to IoT

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs.

IoT & M2M

Machine to Machine, Difference between IoT and M2M, Software define Network.

Network & Communication Aspects

Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.

Challenges in IoT

Design challenges, Development challenges, Security challenges, other challenges.

Domain specific applications of IoT

Home automation, Industry applications, Surveillance applications, Other IoT applications.

Developing IoTs

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python.

Books

1. Jeeva Jose, Internet of Things, Khanna Publishing House.
2. Madisetti V. and Bahga A., Internet of Things: A Hands-On Approach.
3. Dargie W. and Poellabauer C., Fundamentals of Wireless Sensor Networks: Theory and Practice.

OE – AUE 811C: Soft Computing

Subject Code : OE – AUE 811C
Category : Professional Elective Courses
Subject Name : Non-Destructive Testing Methods
Semester : Eighth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students Will be able to:

CO1	Understand the basic concept of soft computing and hard computing and apply them in designing solution to engineering problem.
CO2	Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications to solving engineering and other problems.
CO3	Apply fuzzy logic and reasoning to handle uncertainty and solving interdisciplinary engineering problems
CO4	Use genetic algorithms to combinatorial optimization problems and recognize the feasibility of applying a soft computing methodology for a particular problem.
CO5	To understand the concept and techniques of designing and implementing of soft computing methods in real world problem.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	3	3	-	-	-	-	-	2
CO 3	3	3	3	3	3	3	-	-	-	-	-	2
CO 4	3	3	3	3	3	-	-	-	1	1	-	2
CO 5	3	3	3	3	-	3	-	-	2	2	-	2

Syllabus (PE AUE 812 A)

Neural Networks– I (Introduction and Architecture)

Neuron, Nerve Structure and Synapse, Artificial Neuron and its Model, Activation Functions, Neural Network Architecture: Single Layer and Multilayer Feed Forward Networks, Recurrent Networks. Various Learning Techniques; Perception and Convergence Rule, Auto Associative and Hetro-Associative Memory.

Neural Networks– II (Back Propagation Networks) Architecture

Perceptron Model, Solution, Single Layer Artificial Neural Network, Multilayer Perception Model; Back Propagation Learning Methods, Effect of Learning Rule Co-Efficient; Back Propagation Algorithm, Factors Affecting Back Propagation Training, Applications.

Fuzzy Logic– I (Introduction)

Basic Concepts of Fuzzy Logic, Fuzzy Sets and Crisp Sets, Fuzzy Set Theory and Operations, Properties of Fuzzy Sets, Fuzzy and Crisp Relations, Fuzzy to Crisp Conversion.

Fuzzy Logic– II (Fuzzy Membership, Rules)

Membership Functions, Interference in Fuzzy Logic, Fuzzy If-Then Rules, Fuzzy Implications and Fuzzy Algorithms, Fuzzifications and Defuzzificataions, Fuzzy Controller, Industrial Applications.

Genetic Algorithm (GA)

Basic Concepts, Working Principle, Procedures of GA, Flow Chart of GA, Genetic Representations, (Encoding) Initialization and Selection, Genetic Operators, Mutation, Generational Cycle, Applications.

Books

1.Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
2. S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy logic and genetic Algorithms “,PHI
3. Principles of Soft Computing”, S.N. Sivanandam, S. Sumathi, John Wiley and Sons
4. Genetic Algorithms in Search, Optimization and Machine Learning”, David E. Goldberg, Addison Wesley, 1997.
5. Neural Networks, Fuzzy logic, and Genetic Algorithms”, S. Rajasekaran & G. A. V. Pai , PHI
6.Neural Network, S. Haykin, Pearson Education, 2ed, 2

Department of Automobile Engineering

OE – AUE 812B: Entrepreneurship Development

Subject Code : OE – AUE 812B
Category : Open Elective Courses
Subject Name : Non-Destructive Testing Methods
Semester : Eighth
L-T-P : 3-0-0
Credit : 3
Stream : B. Tech (For AUE)
Full Marks : 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Course Outcome (CO)

Students Will be able to:

CO1	Describe various factors and skills needed to run a business successfully.
CO2	Interpret key regulations and legal aspects of entrepreneurship in India
CO3	Develop the idea behind the concept of business plan and ownerships.
CO4	Evaluate the roots of financial growth and business account module of existing business.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	-	-	3	2	-	-	-	2	2
CO 2	3	3	-	-	-	3	3	2	1	-	3	2
CO 3	3	2	2	3	3	2	3	2	3	2	3	3
CO 4	3	2	1	2	3	2	2	2	2	1	2	2

Syllabus (PE AUE 812 A)

Entrepreneurship

Types of Entrepreneurs– Difference between Entrepreneur and Intrapreneur, Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth

Motivation

Major Motives Influencing an Entrepreneur– Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test– Stress Management, Entrepreneurship Development Programs – Need, Objectives.

Business

Small Enterprises– Definition, Classification– Characteristics, Ownership Structures– Project Formulation– Steps involved in setting up a Business– identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment– Preparation of Preliminary Project Reports– Project Appraisal– Sources of Information– Classification of Needs and Agencies.

Financing And Accounting

Need– Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation– Income Tax, Excise Duty– Sales Tax.

Support To Entrepreneurs

Sickness in small Business– Concept, Magnitude, Causes and Consequences, Corrective Measures– Business Incubators– Government Policy for Small Scale Enterprises– Growth Strategies in small industry– Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

Books

1. Khanka S.S., Entrepreneurial Development, S. Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.

2. Kuratko D.F., Entrepreneurship- Theory, Process and Practice, 9th Edition, Cengage Learning.

3. Hisrich R.D. and Peters M.P., Entrepreneurship, 8th Edition, McGraw-Hill, 2013.

4. Manimala M.J., Entrepreneurship Theory at Cross Roads: Paradigms and Praxis, 2nd Edition, Dreamtech, 2005.

5. Roy R., Entrepreneurship, 2nd Edition, Oxford University Press, 2011.

PC – AUE 881: Comprehensive Viva Voce

Subject Code : PC – AUE 881
Category : Professional Core Courses
Subject Name : Comprehensive Viva Voce
Semester : Eighth
L-T-P : 0-0-0
Credit : 2
Stream : B. Tech (For AUE)
Full Marks : 100 (100 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Reproduce confidence and strength to display integrated understanding of the courses.
CO2	Develop interview skills.
CO3	Define industrial and societal problem solution by effective communication.
CO4	Examine technical knowledge in most effective manner for industries.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	3	2	1	1	1	2	2	3	3
CO 2	3	1	1	2	-	1	-	-	-	3	-	2
CO 3	2	3	3	3	1	-	-	-	3	3	2	1
CO 4	3	1	3	3	-	-	-	-	3	2	1	2

Department of Automobile Engineering

PW – AUE 882: Project IV

Subject Code : PW – AUE 882
Category : Project
Subject Name : Non-Destructive Testing Methods
Semester : Eighth
L-T-P : 0-0-12
Credit : 6
Stream : B. Tech (For AUE)
Full Marks : 100 (100 for End Semester Exam.)

Course Outcome (CO)

Students will be able to:

CO1	Identify real world problems
CO2	Explain design methodologies & its implementation
CO3	Compose technical report writing
CO4	Design advanced techniques to achieve the desired output.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	2	2	2	3	2	3	3
CO 2	3	3	3	3	2	2	2	1	1	2	1	2
CO 3	3	3	3	3	2	1	1	2	3	2	2	2
CO 4	3	3	3	3	-	1	1	-	2	3	1	1