J. S. UNIVERSITY, SHIKOHABAD, FIROZABAD-283135, U.P., INDIA

(Established by the Government of U.P. and recognized as per section 2(f) of UGC Act, 1956)

STUDY&EVALUATIONSCHEMEWITHSYLLABUS

FOR

B.TECH. 3rdYEAR

MECHANICALENGINEERING

Session: 2020-21

B. Tech Mechanical Engineering
Evaluation Scheme

SEMESTER-V													
Sl. No.	**Subject Codes**	**Subject**	**Periods per Week**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
THEORY SUBJECT													
1	BTME-501	Heat and Mass Transfer	3	1	0	30	20	50		100		150	4
2	BTME-502	Strength of Material	3	1	0	30	20	50		100		150	4
3	BTME-503	Industrial Engineering	3	1	0	30	20	50		100		150	4
4	BTME-504	Departmental Elective-I	3	0	0	30	20	50		100		150	3
5	BTME-505	Departmental Elective-II	3	0	0	30	20	50		100		150	3
6	BTLD-501	Constitution of India, Law and Engineering	2	0	0	15	10	25		50			0
PRACTICA/DRAWING SUBJECTS													
7	BTME-551P	Heat Transfer LAB	0	0	2				25		25	50	1
8	BTME-552P	Python Lab	0	0	2				25		25	50	1
9	BTME-553P	Internet of Things Lab	0	0	2				25		25	50	1
10	BTME-554P	Mini Project or Internship Assessment*	0	0	2				50			50	1
		MOOCs (Essential for Hons. Degree)											
		Total										**950**	**22**

*The Mini Project or internship (4 - 5 weeks) conducted during summer break after IV semester and will be assessed during V semester.

Departmental Elective–I	BTME-504	Automobile Engines & Combustion
	BTME-504	I C Engine Fuel and Lubrication
	BTME-504	Finite Element Methods
	BTME-504	Mechatronics Systems
	BTME-504	Computer Integrated Manufacturing

Departmental Elective–II	BTME-505	Advance welding
	BTME-505	Programming, Data Structures And Algorithms Using Python
	BTME-505	Mechanical Vibrations
	BTME-505	Fuels and Combustion
	BTME-505	Automotive chassis and suspension

SEMESTER-VI

Sl. No.	Subject Codes	Subject	Periods per Week			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
THEORY SUBJECT													
1	BTME-601	Refrigeration and Air Conditioning	3	1	0	30	20	50		100		150	4
2	BTME-602	Machine Design	3	1	0	30	20	50		100		150	4
3	BTME-603	Theory of Machine	3	1	0	30	20	50		100		150	4
4	BTME-604	Departmental Elective-III	3	0	0	30	20	50		100		150	3
5	BTME-605	Open Elective-I	3	0	0	30	20	50		100		150	3
6	BTAT-602	Indian Tradition, Culture and Society	2	0	0	15	10	25		50			0
PRACTICA/DRAWING SUBJECTS													
7	BTME-651P	Refrigeration and Air Conditioning Lab	0	0	2				25		25	50	1
8	BTME-652P	Machine Design Lab	0	0	2				25		25	50	1
9	BTME-653P	Theory of Machine Lab	0	0	2				25		25	50	1
		Total										**900**	**21**

Departmental Elective–III	BTME-604	Non-destructive Testing
	BTME-604	Artificial Intelligence
	BTME-604	Tribology
	BTME-604	Gas Dynamics and Jet Propulsion
	BTME-604	Automotive Electrical and Electronics

Open Elective-I	BTME-605	Real time Systems
	BTME-605	Computer based Numerical Techniques
	BTME-605	GIS & Remote sensing
	BTME-605	Basics of data base management system
	BTME-605	Software project Management

Objectives:

The objective of this course is to impart knowledge on design of heat and mass transfer equipments . In addition, it also imparts knowledge on optimization of the cost of heat transfer operations used in bioprocess industries.

SubjectCode:BTME-501	Heat and Mass Transfer	L TP:3 1 0	Credits:4
The students will be able to			
CO-1	Understand the fundamentals of heat and mass transfer.		
CO-2	Apply the concept of steady and transient heat conduction.		
CO-3	Apply the concept of thermal behavior of fins.		
CO-4	Apply the concept of forced and free convection.		
CO-5	Apply the concept of radiation for black and non-black bodies.		
CO-6	Conduct thermal analysis of heat exchangers.		

UNIT-1

Introduction to Heat Transfer **(L-5Hours)**

Introduction of thermodynamics and Heat Transfer, Modes of Heat Transfer: Conduction, convection and radiation, Effect of temperature on thermal conductivity of different types of materials, Introduction to combined heat transfer mechanism, General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems, Initial and system boundary conditions.

Steady State one-dimensional Heat conduction **(L-3 Hours)**

Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation, Concept of thermal resistance, Analogy between heat and electricity flow, Thermal contact resistance and over-all heat transfer coefficient, Critical radius of insulation for cylindrical, and spherical bodies.

UNIT-2

Fins **(L-3Hours)**

Heat transfer through extended surfaces and its classification, Fins of uniform cross –sectional area, Error in measurement of temperature of thermometer wells.

Transient Conduction **(L-3Hours)**

Transient heat conduction, Lumped capacitance method, Time constant, Unsteady state heat conduction in one dimension only, Heisler charts and their applications.

UNIT-3

Forced Convection **(L-5Hours)**

Basic concepts: Hydrodynamic boundary layer, Thermal boundary layer, Approximate integral boundary layer analysis, Analogy between momentum and heat transfer in turbulent flow over a flat surface, Mixed boundary layer, Flow over a flat plate, Flow across a single cylinder and a sphere, Flow insideducts, Thermal entrance region, Empirical heat transfer relations, Relation between fluid friction and heat transfer, Liquid metal heat transfer.

Natural Convection **(L-5Hours)**

Physical mechanism of natural convection, Buoyant force, Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates, cylinders and sphere, combined free and forced convection, Effect of turbulence.

UNIT-4

Thermal Radiation **(L-8Hours)**

Basic concepts of radiation, Radiation properties of surfaces, Black body radiation Planck's law, Wein's displacement law, Stefan-Boltzmann law, Kirchhoff's law, Gray body, Shape factor, Black-body radiation, Radiation exchange between diffusen on; black bodies in anenclosure, Radiation shields, Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect, Radiation net work analysis.

UNIT-5

Heat Exchanger **(L-5Hours)**

Different types of heat exchangers, Fouling factors, Overall heat transfer coefficient, Logarithmic mean temperature difference (LMTD) method, Effectiveness; number of transfer unit (NTU) method and Compact Heat Exchangers.

Condensation and Boiling **(L-3Hours)**

Introduction of condensation phenomena, Heat transfer relations for laminar film condensation on vertical surfaces and on outside& inside of a horizontal tube, Effect of non-condensable gases, Drop wise condensation, Heat pipes, Boiling modes, pool boiling, Hysteresis in boiling curve, Forced convection boiling.

Introduction to Mass Transfer **(L-2Hours)**

Introduction of Fick's law of diffusion, Steady state equimolar counter diffusion, Steady state diffusion through a stagnant gas film, Heat and Mass Transfer Analogy-Convective Mass Transfer Correlations

Reference Books:

1. FundamentalsofHeatandMassTransfer,byIncroperra&DeWitt,JohnWileyandSons
2. Heat and Mass Transfer by Cengel, Mc Graw-Hill
3. Heat Transfer by J.P.Holman, Mc Graw-Hill
4. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education
5. Heat Transfer by Ghoshdastidar, Oxford University Press
6. A text book on Heat Transfer, by Sukhatme, University Press.
7. Heat Transfer by Venkateshan, Ane Books Pvt Ltd
8. Schaum's outline of Heat Transfer by Pitts& Sisson McGraw-Hill
9. Heat and Mass Transfer by R Yadav, Central Publishing House

Objectives:

- To understand the nature of stresses induced in material under different loads.
- To plot the variation of shear force and bending moments over the beams under different types of loads.
- To understand the behavior of beams subjected to shear loads.
- To understand the behavior of beams under complex loading.
- To analyze the cylindrical shells under circumferential and radial loading

SubjectCode:BTME-502	Strength of Material	L TP:3 1 0	Credits:4

Course Outcomes: The student will be able to	
CO1	Understand the concept of stress and strain under different conditions of loading
CO2	Determine the principal stresses and strains in structural members
CO3	Determinethestressesandstrainsinthememberssubjectedtoaxial,bendingand Torsional loads
CO4	Applytheconceptsofstressesandstraininsolvingproblemsrelatedtosprings, Column and pressure vessels
CO5	Calculate the slope, deflection and buckling of loaded members
CO6	Analyze the stresses developed in straight and curved beams of different cross sections

Unit-I **8Hours**

Compound stress and strains: Introduction, normal stress and strain, shear stress and strain, stresses on inclines sections, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's circle for plane stress, three dimensional states of stress & strain, equilibrium equations, generalized Hook's law, theories of failure. Thermal Stresses.

Unit-II **8Hours**

Stresses in Beams: Pure Bending**,** normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams.

Deflection of Beams: Differential equation of the elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams

Torsion: Torsion combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes.

Unit-III **8Hours**

Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin ended columns, effect of end conditions on column buckling, Ranking Gord on formulae, examples of columns in mechanical equipment and machines.

Unit-IV **8Hours**

Thin cylinders spheres:

Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain.

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits.

Unit-V **8Hours**

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.

Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.

Text Books:

1. Strength of materials by Sadhu Singh, Khanna Book Publishing Co.(P)Ltd.
2. Strength of Material by Rattan, MCGRA WHILL INDIA
3. Mechanics of Materials by B.C. Punmia, Laxmi Publications (P)Ltd.

Reference Books:

1. Mechanics of Materials by Hibbeler, Pearson.
2. Mechanics of material by Gere, Cengage Learning
3. MechanicsofMaterialsbyBeer,Jhonston,DEwolfandMazurek,MCGRAWHILLINDIA
4. Strength of Materials by Pytel and Singer, Harper Collins
5. Strength of Materials by Ryder, Macmillan.
6. Strength of Materials by Timoshenko and Yσungs, East West Press.
7. Introduction to Solid Mechanics by Shames, Pearson
8. Mechanics of material by Pytel, Cengage Learning
9. An Introduction to Mechanics of Solids by Crand all, MCGRA WHIL LINDIA
10. Strength of Materials by Jindal, Pearson Education
11. Strength of Materials by Basavajaiah and Mahadevappa, University Press.

Industrial Engineering

Objectives:

- Design and improve production processes: Optimize production efficiency through redesigning equipment and refining processes.
- Increase productivity: Identify areas of improvement, reduce waste, and implement best practices.
- Reduce costs: Streamline processes, negotiate better contracts, and find more efficient ways to use resources.
- Improve quality: Develop quality control systems, design testing protocols, and implement measures for improvement.
- Enhance safety: Create and maintain a safe work environment through identifying potential hazards and providing training.

SubjectCode:BTME-503	Industrial Engineering	L TP:3 1 0	Credits:4

Course Outcomes: The students will be able to	
CO1	Understand the concept of production system, productivity, facility and process planning in various industries
CO2	Apply the various forecasting and project management techniques
CO3	Apply the concept of break-even analysis, inventory control and resource Utilization using queuing theory
CO4	Apply principles of work study and ergonomics for design of work systems
CO5	Formulate mathematical models for optimal solution of industrial problems using Linear programming approach

Unit-I

Overview of Industrial Engineering: Types of production systems, concept of productivity, productivity measurement in manufacturing and service organizations, operations strategies, liability and process design.

Facility location and layout: Factors affecting facility location; principle of plant layout design, types of plant layout; computer aided layout design techniques; assembly line balancing; materials handling principles, types of material handling systems, methods of process planning, steps in process selection, production equipment and tooling selection, group technology, and flexible manufacturing.

Unit-II

Production Planning and control: Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; materials requirement planning(MRP)and MRP-II; routing, scheduling and priority dispatching, concept of JIT manufacturing system

Project Management: Project network analysis, CPM, PERT and Project crashing.

Unit-III

Engineering economy and Inventory control: Methods of depreciation; break-even analysis, techniques for evaluation of capital investments, financial statements, time-cost trade -off, resource levelling; Inventory functions, costs, classifications, deterministic inventory models, perpetual and periodic inventory control systems, ABC analysis, and VED analysis.

Queuing Theory: Basis of Queuing theory, elements of queuing theory, Operating characteristics of a queuing system, Classification of Queuing models.

Unit-IV

Work System Design: Taylor's scientific management, Gilbreths's contributions; work study: method study, micro-motion study, principles of motion economy; work measurement–time study, worksampling, standard data, Predetermined motion time system (PMTS); ergonomics; job evaluation, merit rating, incentive schemes, and wage administration.

Product Design and Development: Principles of product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, and concurrent engineering.

Unit-V

Operational Analysis: Formulation of LPP, Graphical solution of LPP, Simplex Method, Sensitivity Analysis, degeneracy and unbound solutions. transportation and assignment models; Optimality test: the steppingstone method and MODI method, simulation.

Books and References:

1. IndustrialEngineeringandProductionManagementbyMartandTTelsangS.ChandPublishing
2. IndustrialEngineeringandProductionManagementbyM.MahajanDhanpatRai&Co.(P)Limited
3. IndustrialEngineeringandManagementbyRaviShankar,GalgotiaPublicationsPvtLtd
4. Production and Operations Management by Adam, B.E.& Ebert, R. J., PHI
5. Product Design and Manufacturing by Chitale A. V. and Gupta R.C.,PHI
6. OperationsResearchTheory&ApplicationsbyJKSharma,MacmillanIndiaLtd,
7. Production Systems Analysis and Control by J.L. Riggs, John Wiley& Sons
8. Automation,ProductionSystems&ComputerIntegratedManufacturingbyGroover,M.P.PHI
9. OperationsResearch,byA.M.Natarajan,P.Balasubramani,A.Tamilarasi,PearsonEducation
10. Operations Research by P.K. Gupta and D.S. Hira, S. Chand & Co.

Heat and Mass Transfer Lab

Objectives:

- Measure thermal conductivity: Measure the ability of materials to conduct heat.
- Study heat transfer modes: Study conduction, convection, and radiation heat transfer modes.
- Determine heat transfer coefficients: Measure the rate of heat transfer between fluids.
- Study heat exchangers: Study the performance of different types of heat exchangers.
- Study mass transfer phenomena: Study diffusion and convection mass transfer phenomena.

SubjectCode:BTME-551P	Heat and Mass Transfer Lab	L TP:0 0 2	Credits:1

The students will be able to	
CO-1	Apply the concept of conductive heat transfer.
CO-2	Apply empirical correlations for both forced and free convection to determine The value of convection heat transfer coefficient
CO-3	Apply the concept of radiation heat transfer for black and grey body.
CO-4	Analyze the thermal behavior of parallel or counter flow heat exchangers
CO-5	Conduct thermal analysis of a heat pipe

List of Experiments

Minimum eight experiment of the following

1. To determine thermal conductivity of conductive material(s).
2. To determine thermal conductivity of insulating material(s).
3. To determine heat conduction through lagged pipe.
4. To determine heat transfer through fin under natural convection.
5. To determine the heat transfer Rate and Temperature Distribution for a Pin Fin.
6. Determination of thermal conductivity of different types of fluids.
7. Experiment on Stefan's Law-determination of emissivity, etc.
8. Experimentonconvectiveheattransferthroughflatplatesolarcollector.
9. TocompareLMTDandEffectivenessofParallelandCounterFlowHeatExchangers.
10. To find the heat transfer coefficient for Forced Convection in a tube.
11. To find the heat transfer coefficient for Free Convection in a tube.
12. To conduct experiments on heat pipe.
13. To study the rates of heat transfer or different materials and geometries.
14. Visit to a Thermal Power Station for practical exposure.

Python Lab

Objectives

- Introduction to Python: Learn basic Python syntax and data structures.
- Control structures: Learn how to use if-else, for and while loops.
- Functions: Learn how to write and use functions.
- Modules: Learn how to create and use Python modules.
- File handling: Learn how to read from and write to files.

SubjectCode:BTME-552P	**Python Lab**	**L TP:0 0 2**	**Credits:1**

Course out comes: The students will be able to	
CO1	Apply conditional statement, loops condition and functions in python program
CO2	Solve mathematical and mechanical problems using python program
CO3	Plot various type of chart using python program
CO4	Analyze the mechanical problem using python program

List of Python Program

1. Write a program to find root of quadratic equation
2. Write a program to find and delete repeating number in Given List
3. Write a program to input and print the element sum of user defined matrix
4. Write a program to input and multiply two different matrices
5. Write a program to compute eigen value and vector of a given 3*3 matrix using Num Py
6. Write a program to find a solution of linear equations in y = m x +c
7. Write a program to draw line using equation y = m x +c
8. Write the program to determine the intersection point of two line.
9. Draw various types of charts using mat plot lib
10. Write a program to perform equations of uniform motion of kinematics:

i. $v= u+ at0$
ii. $s= ut+ ½(at^2)$
iii. $v^2=u^2– 2as$

11. Write a menu driven program to perform following properties of thermodynamics as given below:

i. First Law of thermodynamics (U=Q-W), where ΔU is the change in the internal energy. Q is the heat added to the system, and W is the work done by the system.
ii. Efficiency of Heat Engine = TH–TC/TH where TH& TC is the temperature of HOT and COLD reservoirs.

12. Write the menu program to find the to find the out relationship between stress and strain curve as given below:

i. Young's Modulus
ii. Shear Modulus
iii. Poisson Ratio

13. Write the program to determine the shear force and bending moment in beams.
14. Write a program to find maxima/minima of functions of two variables and evaluate some real definite and finite integrals.
15. WriteaProgramtofindoutunknownmagnitudeofTBandTDofunknowntensioncanbeobtainedfrom two scalar equations of equilibriumi. eE F_x= 0andEF_y=0.

16. Writeaprogramtoperforminterpolationofequallyandunequallyspaceddata.
17. Write a program to calculate total pressure exerted in ideal fluid as equation is given below:$p+1/2(\rho v^2)+\rho gh=constant$
    Where P is Pressure, V is Velocity of fluid, ρ is density and h is the height of the container.
18. WriteaprogramtofindnumericaldifferentiationusingFinitedifferencesMethodbyimportingNumPyandplotthenumericalvaluesusingmatplotliblibrariesofpython.
19. Write a program for bresenham's line drawing algorithm.
20. Write a program for geometric transformation of a given object.

Internet of Things Lab

Objectives:

- Introduction to IoT: Understand the concept, history, and future of IoT.
- IoT devices and platforms: Learn about IoT devices and platforms such as Raspberry Pi and Arduino.
- IoT sensors: Learn about different types of IoT sensors and their applications.
- IoT data communication: Learn about IoT communication protocols such as MQTT and HTTP.
- IoT data analytics: Learn about data analytics techniques used in IoT.
- IoT security: Learn about security

SubjectCode:BTME-553P	**Internet of Things Lab**	**L TP:0 0 2**	**Credits:1**
The students will be able to			
CO1	Understand Internet of Things and its hardware and software components		
CO2	Interface I/O devices, sensors &communication modules		
CO3	Remotely monitor data and control devices		
CO4	Design prototype of IoT based smart system		
CO5	Develop IoT based projects for real life problem		

List of Experiments:

S. No.	**Name of Experiment**	**Outcome**
1	Familiarization with concept of IoT ,Arduino/Raspberry Pi and perform necessary software installation.	Will be able to understand IoT, Arduino/Raspberry Pi, and also able to install software setup of Arduino/Respberry Pi
2	To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON/OFF motor.	Able to use relay to control motor and other mechanical devices
3	To interface sensors*with Arduino/Raspberry Pi and write a program to display sensors data on the computer screen.	Able to retrieve data from sensors and to display it on computer screen
4	To interface OLED with Arduino/Raspberry Pi and Write a program to display sensor data on it.	Able to retrieved at a from sensors and to Display it on OLED
5	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Relay when sensor data is detected.	Able to control relay with help of micro controller and sensors
6	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Solenoid valve when sensor data is detected.	Able to control Solenoid valve with help of microcontroller and sensors
7	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Linear Actuator When sensor data is detected.	Able to control linear actuator with help of microcontroller and sensors
8	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Starter Motor When sensor data is detected.	Able to control Starter Motor with help of microcontroller and sensors

9	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smart Phone using Bluetooth.	Able to communicate sensor data from micro controller to smart phone
10	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn Actuators* ON/OFF when message is received from smart phone using Bluetooth.	Able to control actuators using mobile phone through Bluetooth
11	Write a program on Arduino/Raspberry Pi to	Able to upload status of devices and
	Upload Sensor data to thing speak cloud.	Sensors on web cloud
12	Write a program on Arduino/Raspberry Pi to retrieve sensors data from thing speak cloud.	Able to retrieve status of devices and sensors from web cloud
13	Develop IOT based smart lock system for Motorcycle/Car	Able to develop smart lock system of motorcycle/car
14	Develop IOT based Smart water flow system	Able to develop smart water flow system
15.	Develop IOT based home security system	Able to develop smart home security system

Components required

1. Arduino with cable
2. Raspberry Pi with cable and memory card
3. Node MCU
4. *Sensors-IR, LDR, DHT11sensor, Pushbutton, Pressure senser, Temperature sensor, Vibration, Rotation, Location, Torque, Sound, Weight etc.
5. *Actuators-LED, Buzzer, Relay Switch, Motors, Motor Drivers, OLED, Display, Linear Actuator, Solenoid Valve, Starter Motor etc.
6. Bluetooth Module, Wi-fi Module, Ethernet Module
7. Smart Phone
8. Computer
9. PowerSupply-5V,12V,3.3V
10. Internet facility

Computer Integrated Manufacturing

Objectives:

- Introduction to CIM: Understand the principles and benefits of CIM.
- Manufacturing processes: Study different manufacturing processes and how they can be integrated.
- CAD/CAM: Learn about computer-aided design (CAD) and computer-aided manufacturing (CAM).
- CNC machines: Study the design and operation of computer numerical control (CNC) machines.
- Robotics: Learn about the design and operation of industrial robots.

Subject Code: BTME-504	**Computer Integrated Manufacturing**	**L TP:3 0 0**	**Credits:3**

Course Outcome: Student will be able to	
CO1	Understand the basic concepts of automation, computer numeric control Machining
CO2	Understandthealgorithmsoflinegeneration,circlegeneration,transformation, curve, surface modeling and solid modeling
CO3	Understand group technology, computer aided process planning, flexible manufacturing,Industry4.0,robotics
CO4	UnderstandinformationsystemandmaterialhandlinginCIMenvironment,rapid Prototyping
CO5	Applythealgorithmsofline&circlegenerationandgeometrictransformations
CO6	Develop CNC program for simple operations

Unit1

Introduction to Computer Integrated Manufacturing (CIM): Introduction to CAD, CAM, CIM, AutomatedManufacturingsystem;Needofautomation,Basicelementsofautomation,Levelsofautomation,Automation Strategies, Advantages & disadvantages of automation, Historical development and futuretrends.ComputerIntegratedManufacturing,Computersinmanufacturingindustries.

Unit2

Principles of Computer Graphics:

Point plotting, drawing of lines, Bresenham's circle algorithm.

Transformation in Graphics:

2Dtransformations–rotation, scaling, translation, mirror, reflection, shear–homogeneous transformations–concatenation,3D transformations.

Curves: Introduction to Hermite cubic splines, Bezier curves, B-spline curves, NURBS

Surface Modeling: Polygon surfaces, quadric surfaces, super quadric surfaces and blob by objects

Solid modeling: Boolean set operations, primitive instancing, Sweep representation, Boundadry representation, Constructive solid geometry,

Unit3

Computer Aided Manufacturing:

NC in CAM – Principal types of CNC machine tools and their constructionfeatures–
toolingforCNC–ISOdesignationfortooling–CNCoperatingsystem
Programming for CNC machining–coordinate systems–manual part programming–computer assisted part programming.

Unit4

Group Technology: Group technology, Cellular Manufacturing, CAPP–Variant and Generative systems

Concurrent Engineering and Design for Manufacturing.
Flexible Manufacturing System: characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects, Industry 4.0.
Robotics: Classification and specification–driveandcontrols–sensors-endeffectors-grippers-toolhandling and work handling – machine vision – robot programming concepts – case studies in assembly. Introduction to Programmable logical controller

Unit5
Data and information in CIM: Management information system in CIM environment, MRP–MRPII–ERP
Capacity planning.
Material handling in CIM environment: Types –AGVS–AS/RS–Swarf handling and disposal of wastes –single and mixed mode assembly lines–quantitative analysis of assembly systems.
Rapid prototyping: Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples.

Books and References:

1. MikellP. Groover- Automation , Production Systems and Computer Integrated Manufacturing, Second edition, Prentice Hall of India.
2. IbrahimZeid-CAD/CAMtheoryandPractice,TataMcGrawHillPublishingCo.Ltd.,CompanyLtd.,NewDelhi.
3. Yoram Koren, Control of machine tools, Mc Graw Hill.
4. Hearn& Baker, Computer Graphics, Prentice Hall of India
5. SunilKumarSrivastava,ComputerAidedDesign:ABasicandMathematicalApproach,IKInternationalPublishingHouse
6. P. Radha krishnan, CAD/CAM/CIM, New Age International(P) Ltd., New Delhi

Subject Code: BTME-505	Mechatronics Systems	L TP:3 0 0	Credits:3

Course Outcome: Student will be able to	
CO1	Identifykeyelementsofmechatronicsanditsrepresentationbyblockdiagram.
CO2	Understand the concept of sensors and use of interfacing systems.
CO3	Understand the concept and applications of different actuators
CO4	Illustrate various applications of mechatronic systems.
CO5	Develop PLC ladder programming and implementation in real life problem.

Unit I: Mechatronics & Its Scope

Mechatronics System: Introduction to Mechatronic Systems, Evolution, Scope, Application Areas, Basic Elements and Control of Mechatronics systems, Advantages anddisadvantagesofMechatronics,IndustrialapplicationsofMechatronics, autotronics, bionics, and avionics and their applications

Control System Concepts: Introduction to Control Systems, Elements of control system, Basic of open and closed loop control with example.

Unit II: Sensor& Transducer

Definition and classification of sensor and transducer, performance terminology, static and dynamiccharacteristics,PrincipleofworkingandapplicationofInductiveProximity,CapacitiveProximity,Photoelectric, Ultrasonic, Magnetic, Hall Effect, Tactile Sensor, load cell, LVDT and interfacing sensors in Mechatronic system.

UNIT III: ACTUATION SYSTEMS

Fluid Based Actuation: Concept of Hydraulic and Pneumatic Actuation system, Oil and Air preparation unit, Direction Control Valve, Pressure Control Valve, Single and doubly actuated systems, Actuators and Accumulators.

Electrical Actuation Systems: Introduction to Switching devices, Concept of Electro Mechanical Actuation, Solenoids and Solenoid Operated Direction Control Valves, Principle of working of DC and 3PhaseInduction Motor, Stepper motors and Servo Motors with their merits and demerits.

UNITIV: INDUSTRIAL CONTROLLERS

Programmable Logic Controllers: Basic Structure, Types and Working Principle, Concept of Scan Cycle and Scan Time,IO's and its Types, Selection Criteria and Applications

Programming Techniques: Ladder diagram –Concept of Contacts and Coil, Latching/ Holding Circuit, Memory Bits, Timers and Counter.

UNITV: MECHATRONICS APPLICATIONS:

Control of conveyor motor, sorting and packaging unit, pick and place robot, coin counter, operations of bottling plant, domestic washing machine, use of PLC for extending and retracting pneumatic pistons and their different combinations, automatic carpark system, engine management system, other applications in manufacturing.

Text Books:

1. RolfIsennann, "Mechatronics Systems" ,Springer, 2005.
2. W. Bolten, "Mechatronics", Pearson Education 2003.
3. HMT Ltd, "Mechatronics:, Tata Mc Graw Hill 1998.
4. K.P. Rama chandran, G.K. Vijayaraghavan, M.S. Balasundaram, Mechatronics; Integrated Mechanical Electronic Systems, Wiley.

Reference Books

1. I.C Engine Analysis & Practice by E. F Obert.
2. Internal Combustion Engine Fundamentals, by John B. Heywood, Tata Mc graw Hill Publishers.
3. Engine Emission, by B. B. Pundir, Narosa Publication.
4. EngineeringFundamentalsofInternalCombustionEnginesbyW.W.Pulkrabek,Pearson Education.
5. Fundamentals of Internal Combustion Engine by Gill,Smith, Ziurs, Oxford& IBH Publishing CO.
6. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India.

Departmental Elective – I
Semester –V

Automobile Engines &Combustion

Objectives:

- Introduction to engines: Understand the principles of engine operation and different engine types.
- Engine components: Study the design and function of engine components such as cylinders, pistons, and valves.
- Engine cycles: Learn about the Otto, Diesel, and Atkinson cycles.
- Combustion process: Study the process of combustion in engines.
- Fuel systems: Study the design and operation of fuel systems in engines.

Subject Code: BTME-506	Automobile Engines &Combustion	L TP:3 0 0	Credits:3

CO	Course Outcome
CO1	Explain the working principle, performance parameters and testing of IC Engine.
CO2	Understand the phenomena of combustion and its application in SI and CI engines.
CO3	Understand the essential systems of IC engine.
CO4	Understand the effect of engine emissions on environment and human health and Methods of reducing it.
CO5	Apply the concepts of thermodynamics to air standard cycle in IC Engines
CO6	AnalyzetheeffectofvariousoperatingparametersonICengineperformance. K4

Unit-I **(8Hours)**

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram, Valve mechanism-Pushrod type, Over head type(SOHC,DOHC).

Thermodynamic analysis of Air standard cycles: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.

Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines.

Unit–II **(8Hours)**

Combustion and Flames Propagation:

Chemical composition– Flue gas analysis, Dew point of products, Stoichiometry, Stoichiometry relations, theoretical air required for complete combustion, Enthalpy of formation, Heating value of fuel, Adiabatic flame Temperature, Chemical equilibrium.

Flame stability, Burning velocity of fuels, Measurement of burning velocity, Factors affecting the burning velocity, Flame Propagation, Flame Temperature– Theoretical, Adiabatic & Actual, Ignition Limits, Limits of Inflammability.

Unit–III **(7Hours)**

Combustion: Stages of Combustion in SI & CI engine, Factors affecting combustion, Flame speed, Ignition Delay, Abnormal combustion and its control.

Combustion chamber: Squish, Swirl & tumble, Combustion chamber design for SI & CI engine & factors affecting it.

Ignition System in SI Engine: Ignition system requirements, Magneto and battery ignition systems, ignition timing and sparkplug, Electronic ignition.

Unit-IV **(9Hours)**

Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine, MPFI, Scavengingin2Stroke engines. Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. Turbo charging & its types-Variable Geometry Turbo charger, Waste Gate Turbo charger, Effect of turbo charging on power &emission.

UNIT-V **(8Hours)**

Engine Emission and Control: Pollutant-Sources and types – Effect on environment and human health –formation ofNOx-HydrocarbonEmissionMechanism-CarbonMonoxideFormation-Particulateemissions-Methods of controlling Emissions-Catalytic converters and Particulate Traps-Selective Catalytic Reduction (SCR) -Diesel Oxidation Catalyst (DOC).
Fuels & Lubricants: Fuels for SI and CI engine, Rating of SI engine and CI engine fuels, Gaseous fuels, LPG, CNG, Biogas, Different cooling systems, Type of lubrication, Lubrication oils, Crank case ventilation.

Text Books

3. A Course in International Combustion Engines, by Mathur &Sharma, Dhanpat Rai &Sons.
4. Fuels and combustion, Sharma and Chander Mohan, Tata Mc Graw Hill
5. I.C Engine, by Ganeshan, Tata Mc Graw Hill Publishers.

Reference Books

7. I. C Engine Analysis & Practice by E. F Obert.
8. Internal Combustion Engine Fundamentals, by John B. Heywood, Tata Mc graw Hill Publishers.
9. Engine Emission, by B. B. Pundir, Narosa Publication.
10. EngineeringFundamentalsofInternalCombustionEnginesbyW.W.Pulkrabek,Pearson Education.
11. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford& IBH Publishing CO.
12. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India.

IC Engine, Fuel and Lubrication

Objectives:

- Introduction to IC engines: Understand the principles and types of internal combustion engines.
- Combustion process: Study the process of combustion in IC engines.
- Fuel systems: Study the design and operation of fuel systems in IC engines.
- Lubrication systems: Study the design and operation of lubrication systems in IC engines.
- Engine performance: Learn about performance parameters of IC engines, such as power and efficiency.

Subject Code: BTME-507	**IC Engine, Fuel and Lubrication**	**L TP:3 0 0**	**Credits:3**

CO	**Course Outcome**
CO1	Explain the working principle, performance parameters and testing of I C Engine.
CO2	Understand the combustion phenomena in S I and C I engines and factors Influencing combustion chamber design.
CO3	UnderstandtheessentialsystemsofICengineandlatesttrendsanddevelopments In I C Engines.
CO4	Understand the effect of engine emissions on environment and human health and methods of reducing it.
CO5	Apply the concepts of thermodynamics to air standard cycle in I C Engines
CO6	AnalyzetheeffectofvariousoperatingparametersonICengineperformance.

Unit-I **(9Hours)**

Introduction to I. C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram, Valve mechanism-Pushrod type, Over head type(SOHC,DOHC).Thermodynamic analysis of Air standard cycles: Otto cycle,Dieselcycle,Dualcycle,ComparisonofOtto,DieselandDualcyclesFuelaircycle,factor affecting the fuel air cycle, Actual cycle. Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of S I and C I engines.

Unit–II **(7Hours)**

Combustion: Stages of Combustion in SI & CI engine, Factors affecting combustion, Flame speed, Ignition Delay, Abnormal combustion and its control. Combustion chamber: Squish, Swirl &tumble, Combustion chamber design for SI & CI engine & factors affecting it.

Unit–III **(8Hours)**

Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine, MPFI, Scavengingin2Stroke engines.
Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings.
Turbo charging & its types; Variable Geometry Turbo charger, Waste Gate Turbo charger, Effect of turbo charging on power &emission.

Unit-IV **(9Hours)**

Engine Emission and Control: Pollutant-Sources and types – Effect on environment and human health -formation of NOx-Hydrocarbon Emission Mechanism-Carbon Monoxide Formation-Particulate emissions-Methods of controlling Emissions - Catalytic converters and Particulate Traps -Selective Catalytic Reduction (SCR)-Diesel Oxidation Catalyst (DOC).

Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines.

UNIT-V **(9Hours)**

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crank case ventilation. Ignition System in SI Engine: Ignition system requirements, Magneto and battery ignition systems, ignition timing and sparkplug, Electronic ignition. Recent trends in IC engine: Lean burn engine, Stratified charge spark ignition engine, Homogeneous charge spark ignition engine, GDI.

Finite Element Methods

Objectives:

- To obtain an approximate solution to a mathematical model or system of equations governing a physical problem, where analytical solutions are not feasible or practical.
- To provide an efficient method for solving partial differential equations (PDEs) and other complex engineering problems, such as fluid flow, heat transfer, and structural analysis.
- To allow engineers and scientists to optimize the design of a product or system by predicting the behavior of the system under various conditions.
- To provide a means for analysing complex systems, such as composite materials or structures with complicated geometries.

Subject Code: BTME-508	**Finite Element Methods**	**L TP:3 0 0**	**Credits:3**

Course Outcome: Student will be able to	
CO1	Understand the basic concepts of FEM and its applications.
CO2	ApplytheprocedureinvolvedtosolveaproblemusingFiniteElementMethods.
CO3	Develop the element stiffness matrices using different approach.
CO4	Analyze1Dand2Dproblemusingdifferentmethods.
CO5	Analyze the complex geometric problems through FEM software packages.

Unit1

Introduction, exact solution vs approximate solution, principle of FEM, application of FEM, general procedure for finite element analysis ,pre-processing, solution, post processing, Stresses and Equilibrium; Boundary Conditions.

Unit2

Strain-Displacement Relations, Stress–strain relations, Effect of temperature, various approximate methods: weighted residual method, variational or Rayleigh Ritz method, Galerkin's method, principle of minimum potential energy.

Unit3

Basic element shapes, generalized co-ordinates, polynomials, natural co-ordinates in one-D, two-D and three-dimensions, Lagrange and Hermite polynomials, Application of Finite Element Methods to elasticity problems and heat conduction Problems.

Unit4

One-dimensional problem of finite element model, Coordinates and Shape function, Potential-energy approach, Galerkine approach, Assembly of Global Stiffness Matrix and Load Vector. Plane trusses: Global and local coordinate system and stress calculation. Beams and Frames: finite element formulation and calculation of Shear Force and Bending Moment.

Unit5

Two-dimensional problem using Constant Strain Triangles and Four-node Quadrilateral, Problem modeling and Boundary conditions. Practical consideration in finite element applications, problem solving on a general purpose FEM software package like ANSYS,ABAQUS,NISA etc.

Text Books:

1. Chandrupatla, T. R. and Belegundu,A.K.,IntroductiontoFiniteElementsinEngineering,PearsonEducation,India(2001).
2. Rao,S.S.,Finiteelementmethodinengineering,5thEdition,PergamanInt.LibraryofScience,2010.
3. Huebner,K.H.,TheFiniteElementMethodforEngineers,JohnWiley,NewYork(2001).
4. Logan,D.L.,Afirstcourseinthefiniteelementmethod,6thEdition,CengageLearning,2016.

Mechatronics Systems

Objectives:

- Introduction to mechatronics: Understand the principles and applications of mechatronics.
- Sensors and actuators: Study different sensors and actuators used in mechatronic systems.
- Microcontrollers and embedded systems: Learn about microcontrollers and how they are used in mechatronic systems.
- Control systems: Study different types of control systems used in mechatronics, such as PID control.
- Signal processing: Learn about signal processing techniques used in mechatronic systems**.**

Subject Code: BTME-509	**Mechatronics Systems**	**L TP:3 0 0**	**Credits:3**

Course Outcome: Student will be able to	
CO1	Identifykeyelementsofmechatronicsanditsrepresentationbyblockdiagram.
CO2	Understand the concept of sensors and use of interfacing systems.
CO3	Understand the concept and applications of different actuators
CO4	Illustrate various applications of mechatronic systems.
CO5	Develop PLC ladder programming and implementation in real life problem.

Unit I: Mechatronics & Its Scope

Mechatronics System: Introduction to Mechatronic Systems, Evolution, Scope, Application Areas, Basic Elements and Control of Mechatronics systems, Advantages anddisadvantagesofMechatronics,IndustrialapplicationsofMechatronics, autotronics, bionics, and avionics and their applications

Control System Concepts: Introduction to Control Systems, Elements of control system, Basic of open and closed loop control with example.

Unit II: Sensor& Transducer

Definition and classification of sensor and transducer, performance terminology, static and dynamiccharacteristics,PrincipleofworkingandapplicationofInductiveProximity,CapacitiveProximity,Photoelectric, Ultrasonic, Magnetic, Hall Effect, Tactile Sensor, load cell, LVDT and interfacing sensors in Mechatronic system.

UNITIII: ACTUATION SYSTEMS

Fluid Based Actuation: Concept of Hydraulic and Pneumatic Actuation system, Oil and Air preparation unit, Direction Control Valve, Pressure Control Valve, Single and doubly actuated systems, Actuators and Accumulators.

Electrical Actuation Systems: Introduction to Switching devices, Concept of Electro Mechanical Actuation, Solenoids and Solenoid Operated Direction Control Valves, Principle of working of DC and 3PhaseInduction Motor, Stepper motors and Servo Motors with their merits and demerits.

UNITIV: INDUSTRIAL CONTROLLERS

Programmable Logic Controllers: Basic Structure, Types and Working Principle, Concept of Scan Cycle and Scan Time,IO's and its Types, Selection Criteria and Applications

Programming Techniques: Ladder diagram –Concept of Contacts and Coil, Latching/ Holding Circuit, Memory Bits, Timers and Counter.

UNITV: MECHATRONICS APPLICATIONS:

Control of conveyor motor, sorting and packaging unit, pick and place robot, coin counter, operations of bottling plant, domestic washing machine, use of PLC for extending and retracting pneumatic pistons and their different combinations, automatic carpark system, engine management system, other applications in manufacturing.

Computer Integrated Manufacturing

Objective:

- Streamlining the production process by automating repetitive tasks and eliminating unnecessary steps.
- Improving product quality by ensuring consistency and accuracy in the manufacturing process.
- Reducing production costs by optimizing the use of resources and minimizing waste.
- Increasing production flexibility by enabling manufacturers to quickly reconfigure production processes to accommodate changes in demand or product specifications.
- Improving the speed and responsiveness of the manufacturing process by enabling real-time monitoring and control.

Semester–V: Departmental Elective–I: Specialization–Manufacturing and Automation

Subject Code: BTME-510	**Computer Integrated Manufacturing**	**L TP:3 0 0**	**Credits:3**

Course Outcome: Student will be able to	
CO1	Understand the basic concepts of automation, computer numeric control Machining
CO2	Understandthealgorithmsoflinegeneration,circlegeneration,transformation, curve, surface modeling and solid modeling
CO3	Understand group technology, computer aided process planning, flexible manufacturing,Industry4.0,robotics
CO4	UnderstandinformationsystemandmaterialhandlinginCIMenvironment,rapid Prototyping
CO5	Applythealgorithmsofline&circlegenerationandgeometrictransformations
CO6	Develop CNC program for simple operations

Unit1

Introduction to Computer Integrated Manufacturing (CIM): Introduction to CAD, CAM, CIM, AutomatedManufacturingsystem;Needofautomation,Basicelementsofautomation,Levelsofautomation,Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends. Computer Integrated Manufacturing, Computers in manufacturing industries.

Unit2

Principles of Computer Graphics:
Point plotting, drawing of lines, Bresenham's circle algorithm.
Transformation in Graphics:
2Dtransformations–rotation, scaling, translation, mirror, reflection,shear–homogeneoustransformations–concatenation,3D transformations.
Curves: Introduction to Hermite cubic splines, Bezier curves, B-spline curves, NURBS
Surface Modeling: Polygon surfaces, quadric surfaces, super quadric surfaces and blob by objects
Solid modeling: Boolean set operations, primitive instancing, Sweep representation, Boundadry representation, Constructive solid geometry,

Unit3

Computer Aided Manufacturing:
NC in CAM – Principal types of CNC machine tools and their constructionfeatures–
toolingforCNC–ISOdesignationfortooling–CNCoperatingsystem
Programming for CNC machining–coordinate systems–manual part programming–computer assisted part programming.

Unit4

Group Technology: Group technology, Cellular Manufacturing, CAPP–Variant and Generative system
Concurrent Engineering and Design for Manufacturing.
Flexible Manufacturing System: characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects, Industry 4.0.
Robotics: Classification and specification–driveandcontrols–sensors-endeffectors-grippers-toolhandling and work handling – machine vision – robot programming concepts – case studies in assembly. Introduction to Programmable logical controller

Unit5

Data and information in CIM: Management information system in CIM environment, MRP–MRPII–ERP Capacity planning.

Material handling in CIM environment: Types –AGVS–AS/RS–Swarf handling and disposal of wastes –single and mixed mode assembly lines–quantitative analysis of assembly systems.

Rapid prototyping: Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples.

Books and References:

7. MikellP. Groover- Automation , Production Systems and Computer Integrated Manufacturing, Second edition, Prentice Hall of India.
8. IbrahimZeid-CAD/CAMtheoryandPractice,TataMcGrawHillPublishingCo.Ltd.,CompanyLtd.,NewDelhi.
9. Yoram Koren, Control of machine tools, Mc Graw Hill.
10. Hearn& Baker, Computer Graphics, Prentice Hall of India
11. SunilKumarSrivastava,ComputerAidedDesign:ABasicandMathematicalApproach,IKInternationalPublishingHouse
12. P. Radha krishnan, CAD/CAM/CIM, New Age International(P) Ltd., New Delhi

Advance welding Objective:

- The objective of advance welding is to improve the efficiency, quality, and safety of the welding process. This can be achieved through the development of new welding techniques, the use of advanced materials and equipment, and the implementation of automated and robotic welding systems.
- Advanced welding techniques aim to produce stronger, more durable, and more reliable welds, while also reducing defects and minimizing the risk of welding-related injuries.
- Advancements in welding technology are also focused on reducing the environmental impact of the welding process by minimizing the amount of energy and resources used, and by reducing the amount of waste and emissions produced.

Semester–V: Departmental Elective–II: Specialization– Advance welding

Subject Code: BTME-511	**Advance welding**	**L TP:3 0 0**	**Credits:3**

Course Outcome: Student will be able to	
CO1	Understand the physics of arc welding process and various operating characteristics Of welding power source.
CO2	Analysis various welding processes and their applications.
CO3	Apply the knowledge of welding for repair& maintenance, along with the Weldability of different materials.
CO4	Apply the concept of quality control and testing of weldments in industrial environment.
CO5	Evaluate heat flow in welding and physical metallurgy of weldments.

UNIT-I:

Introduction: Introduction to welding, application, classification and process selection criterion. Health &safety in welding.

Welding Arc: Physics of welding arc, arc initiation, voltage distribution, arc characteristics, arc efficiency, arc temperatures and arc blow. Mechanism and types of metal transfer.

Welding Power Sources: Types of welding power sources, operation characteristics and specifications.

UNIT-II:

Welding Processes: Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW) Gas TungstenArcWelding(GTAW)PlasmaArc,SubmergedArcWelding,ElectrogasandElectroslag,Resistancewelding,Frictionwelding,Brazing,Soldering&Brazewelding.Laserbeamwelding,Electronbeamwelding,Ultrasonicwelding,Explosivewelding,Friction Stir Welding, Under water welding.

Advances in Welding Processes: Narrow Gap, Tandem (Twin/Multi Wire) Welding, A-TIG, Hybrid Welding processes**,** magnetically impelled arc butt (MIAB) welding**,** welding automation and robotic applications.

UNIT-III:

Heat Flow Welding: Weld thermal cycle, Temperature distribution, Peak temperature; Heat Affected Zone (HAZ), heating, cooling and solidification rates.

Welding Metallurgy: Fundamentals of physical metallurgy, Principle of solidification of weld metal, Reactions in weld pool Gas metal reaction, Slag metal reaction, factors affecting changes in microstructure and mechanical properties of HAZ, Micro and macrostructures in weld metal and HAZ

UNIT-IV:

Repair & Maintenance Welding: Hard facing, Cladding, Surfacing, Metallizing processes and Reclamation welding.

Weldability: Effects of alloying elements on weldability, carbon equivalent, welding of plain carbon steel, Stainless steel, Cast Iron and Aluminium alloys, Welding of Dissimilar Materials

UNIT-V:

Weld Design: Types of welds & joints, Welding Symbols, Weld defects and Remedies, Residual Stresses& Distortion, Inspection and testing of welds: Introduction to Non Destructive Techniques; Destructive Techniques : Bulk and Microhardness test, Wear test and types, corrosion test, tensile test, bend test, SEM, EDS and XRD.

Welding Codes, WPS & PQR: Introduction to welding codes, ISO, ASME and BIS specifications, Welding Procedure Specification (WPS) &Procedure Qualification Record (PQR),Welding of pipe; lines and pressure vessels.

Books and References:

1. WeldingandWeldingTechnology,by;RichardL.Little,McGrawHillEducation.
2. WeldingPrincipalsandPractices,by;EdwarsR.Bohnart,McGrawHillEducation.
3. Welding Engineering and Technology, by;R.S.Parmar, Khanna Publishsers.
4. Welding Technology Fundamentals by William. A. Bowditch.
5. Welding Technology by NK Srinivasan.
6. Welding Engineering and Technology by R S Parmar.
7. Modern Welding Technology by Howard B Caryand Scott Helzer.
8. Welding Hand books (Vol.I &II)
9. Advanced Welding Processes, Wood head publishing, J. Norrish
10. ASMESec. IX, Boiler and Pressure Vessel Code

Semester–V:

Departmental Elective–II:

Specialization– **Programming, Data Structures And Algorithms Using Python**

Objective:

- Understanding programming fundamentals: Learning programming fundamentals such as variables, loops, conditional statements, functions, and objects are essential to become proficient in programming using Python.
- Building data structures: Learning how to design, implement, and manipulate data structures such as lists, dictionaries, tuples, sets, and arrays using Python.
- Implementing algorithms: Learning how to write efficient algorithms to solve computational problems such as sorting, searching, and graph traversal using Python.

Subject Code:BTME-512	**Programming, Data Structures And Algorithms Using Python**	**L TP:3 0 0**	**Credits:3**

Course Outcome: Student will be able to	
CO1	Understandthenumbers,math'sfunction,strings,list,tuples,anddictionariesin Pythons
CO2	Apply conditional statement and functions in python
CO3	Apply file handling techniques in python
CO4	Analyze the graphical demonstration in python
CO5	Apply techniques of Classes and Object Concept in Python

UNIT1: Introduction **(8Hours)**

Introduction to Python, Python IDE's, Assignment statement, basic types int, float, complex, bool, Strings, Lists, bytes, byte array, Functions, Loop control statements-break, continue, pass, Anonymous function;filter(),map(),reduce(),more aboutrange().

UNIT2: Data Structure **(7Hours)**

Arrays vs lists, Tuples and dictionaries, Sets, frozen set, Slicing, binary search, Efficiency, Selection Sort ,Insertion Sort, Recursion, Mergesort, Quicksort.

UNIT3: Function and File Handling **(8Hours)**

Function definitions, Global scope, nested functions, Lambda Function, List Comprehension, ExceptionHandling,Standardinputandoutput,Handlingfiles,Stringfunctions, pass,del()andNone

UNIT4: Classes and Object **(8Hours)**

Generating permutations, Stack, Queue, Circular Queue, Abstract data types, classes and objects, Classes and objects in Python, User defined lists, Search trees, Tree, Graph, Hashing

UNIT5: Algorithm **(7Hours)**

Asymptotic Notation – Big-O, Big Omega, Big Theta Notation, Memorization and dynamic programming, Grid paths, longest common subsequence, Matrix multiplication, Algorithms, and programming: simplegcd, improving naive gcd, Euclid's algorithm for gcd.

Reference Books:

1. Guido van Rossum and FredL. DrakeJr, An Introduction to Python –RevisedandupdatedforPython3.2,NetworkTheory Ltd., 2011
2. AllenB.Downey,"ThinkPython:HowtoThinkLikeaComputerScientist,2ndedition,UpdatedforPython3,Shroff/ OReillyPublishers,2016
3. RobertSedgewick,KevinWayne,RobertDondero,IntroductiontoProgramminginPython:AnInter-disciplinaryApproach,PearsonIndiaEducationServicesPvt.Ltd., 2016

Semester–V: Departmental Elective–II: Specialization– Mechanical Vibrations

Objective:

- To design and analyze mechanical systems that can withstand vibration and remain stable.
- To minimize the negative effects of vibration, such as wear and tear, noise, and damage to mechanical components.
- To improve the performance of mechanical systems by reducing vibration levels, increasing efficiency, and enhancing reliability.
- To identify the causes of vibration and develop methods to mitigate them, such as balancing, damping, and isolation.

Subject Code: BTME-513	Mechanical Vibrations	L TP:3 0 0	Credits:3

Course Outcome: Student will be able to	
CO1	Understandfundamentalsofmechanicalvibrationsalongwiththeirclassification.
CO2	Differentiate among single, two and multiple degree of freedom (DOF) systems.
CO3	Analyze,predictandmeasuretheperformanceofsystemsundergoingsingle,two And multiple DOF.
CO4	Design systems with optimized vibration absorption capabilities.
CO5	Apply the fundamentals to the real life problems like whirling of shaft
CO6	SolvecomplicatedmathematicalmodelsusingNumericalmethodsandsoftwareapplications.

UNIT– I **(10Hours)**

Introduction, Classification of Vibration Systems, Harmonic motion, Vector representation of harmonic motion, Natural frequency & response, Effects of vibration, superposition of simple harmonic motions, beats, Fourier analysis-analytical method.

Single Degree Freedom System, Equation of motion, Newton's method, D'Alembert's principle, Energymethodetc.,Freevibration,Naturalfrequency,Equivalentsystems,Displacement,Velocityandacceleration, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations ofsystemswithviscousdamping,Logarithmicdecrement,Energydissipation in viscous damping.

UNIT– II **(8Hours)**

Single Degree Freedom: Forced Vibration Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation,Vibrationisolation,Transmissibility,Vibrationmeasuringinstruments,Displacement,velocity,andaccelerationmeasuring instruments

UNIT-III **(8Hours)**

TwoDegreeFreedomsystemsIntroduction,Principalmodes,Doublependulum,Torsionalsystemwithdamping,Coupledsystem,Principleofvibrationabsorber,Undampeddynamicvibrationabsorbers,Torsionalvibrationabsorber,Centrifugalpendulumabsorbers,VibrationisolatorsandDampers.

UNIT-IV **(10Hours)**

Multi-degree Freedom system: Exact Analysis, Undamped free and forced vibrations of multi-degree freedom systems, influence coefficients, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems: Longitudinal vibrations of bars, Torsional vibrations of circular shafts.

Multi Degree Freedom system: Numerical Analysis by Rayleigh's method, Dunkerley's, Holzer's and Stools methods, Rayleigh: Ritz method.

UNIT-V **(8Hours)**

Critical speed of shafts, Whirling of uniform shaft, Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

Industrial case studies (any two) involving mechanical vibrations, their impact and performance analysis. Introduction to the vibration analysis using MATLAB.

Books and References:

1. Mechanical Vibrations: V.P. Singh, Dhanpatrai &Co.
2. Mechanical Vibrations: G. K. Grover, Jain Brothers, Roorkee.
3. Mechanical Vibrations: Kelly
4. Mechanical Vibrations: Tse, Morse &Hinkle
5. **Case study**
   Reference#1:https://www.ijstr.org/final/print/july2018/Vibration/Analysis/Of/Rotating/Machines/With/Case:Studies.pdf
6. **CasestudyReference#2:**
   https://www.researchgate.net/publication/254227083_Case_studies_of_vibrations_in_structures
7. **CasestudyReference#3:**
   https://pdfs.semanticscholar.org/f2b6/39990c4ba52706f43d02fe1c59b9c3fabf2a.pdf
8. **MOOCreference:**https://www.youtube.com/playlist?list=PLSGws_74K01_pG3R7rgtDtrDZBjcTgPdR
9. **Recommended software packages:**
1. MATLAB
2. Any modelling and FEA too llike NX, Solid works etc.

Semester–V: Departmental Elective–II: Fuels and Combustion

Objective:

- Combustion of fuel is used to generate electricity in power plants. The energy released during combustion is used to heat water and produce steam, which drives turbines to generate electricity.
- Transportation: Combustion of fuel is used to power engines in various modes of transportation, including cars, airplanes, ships, and trains.
- Heating: Combustion of fuel is used for space heating and water heating in residential and commercial buildings. The energy released during combustion is used to heat air or water, which is then circulated throughout the building.

Subject Code:BTME-514	**Fuels and Combustion**	**L TP:3 0 0**	**Credits:3**

	The students will be able to
CO1	Understand thepropertiesofdifferenttypesoffuelwiththeirapplication.
CO2	Classify different types of fuels.
CO3	Understand the concept of combustion.
CO4	Understand the fundamental concept of air pollution and its control.
CO5	Calculate various properties of the fuels.
CO6	Analyze the flue gases.

Unit-I

Classification and Properties of Fuels:

Fuels; Types and characteristics of fuels; Determination of properties of fuels; Fuel analysis Proximate and ultimate analysis: Calorific value(CV),Grossandnetcalorificvalues(GCV,NCV);BombCalorimetry;empiricalequationsforCVestimation

Solid Fuels:

Origin of coal; Ranking of coal; Washing, cleaning, and storage of coal; Renewable Solid Fuels comparative study of Solid, liquid and gaseous fuels; selection of coal for different industrial applications; carbonization of coal

Unit-II

Liquid Fuels:

Origin of crude oil; composition of crude petroleum; classification of crude petroleum; Removal of salt from crude oil; processing of crude petroleum-FractionationdistillationADUandVDUCracking-HydrotreatmentandReforming

Gaseous Fuels:

Rich and lean gas; Wobbe index; Natural gas; Dry and wet natural gas; Foul and sweet NG;LPG LNG; CNG; Methane; Producer Gas; Water gas; Coal Gasification; Gasification Efficiency

Unit-III: Combustion and Flames Propagation

Chemical composition– Flue gas analysis, Dew point of products, Stoichiometry, Stoichiometry relations, theoretical air required for complete combustion, Enthalpy of formation, Heating value of fuel, Adiabatic flame Temperature, Chemical equilibrium.

Flame stability, Burning velocity of fuels, Measurement of burning velocity, Factors affecting the burningvelocity,FlamePropagation–Solid,Liquid&GaseousFuelsCombustion,FlameTemperature–Theoretical,Adiabatic&Actual,IgnitionLimits,LimitsofInflammability.

Unit-IV: Combustion Equipment

Analysis of flue gases by Orsat apparatus; Combustion of solid fuels; grate firing and pulverized fuel firing system; Fluidized bed combustion; Circulating fluidized bed boiler, Oil Burners, Gas Burners, Factors affecting burners and combustion, Combustion in I.C. Engines, Combustioning as turbine and jet engines

Unit-V: Air Pollution

Types of pollution, Combustion generated air pollution, Effects of air pollution, Pollution of fossil fuels and its control, Pollution from automobiles and its control, Emission by diesel engines, Emission Standards.

Text book(s):

1. KennethK.K.,PrinciplesofCombustion,2nded.,WileyPublications,USA,2012
2. Sharma and Chander Mohan, Fuels and combustion, Tata Mc Graw Hill
3. PhillipsH.J.,Fuels-solid,liquid,andgases–Theiranalysisandvaluation,1sted.,FosterPress,USA,2010

Reference Books:

1. SpeightJ.G.,TheChemistryandTechnologyofCoal,3rded.,TaylorandFrancisLtd.,USA,2016
2. SarkarS.,Fuelsandcombustion,3rded.,UniversitiesPress,India,2009

Semester–V: Departmental Elective–II: Automotive chassis and suspension

Objective:

- The chassis and suspension system provide a framework and support for the vehicle body, ensuring that it remains stable and balanced, even when driving over uneven terrain.
- The chassis and suspension work together to absorb and dampen vibrations and shocks from the road, and to provide stability and control during acceleration, braking, and cornering.
- the primary objectives of automotive chassis and suspension are to provide a smooth and comfortable ride, maintain stability and control during driving, and ensure that the vehicle remains in contact with the road surface for optimal handling and safety.

Subject Code: BTME-515	**Automotive chassis and suspension**	**L TP:3 0 0**	**Credits:3**

Course Outcomes: The students will be able to	
CO-1	Understand different types of automotive chassis and frames used in automobiles.
CO-2	Understand transmission and drive line components used in automobile.
CO-3	Understand the axles and types of steering system in automobile.
CO-4	Understand the constructional features of barking, suspension system, wheels and tyres in automobile application.
CO-5	Understand there cent advancements made in chassis components of automobile
CO-6	Apply the concepts of braking and steering system to design the same for automobile application.

Unit-I

Chassis Layouts and Frames

Definition of Chassis, Types of Chassis Layout with reference to Power Plant Location and Drive

Automotive Frames Material Selection and its Constructional Details, Various types, Different Loads acting on Frame, Testing of Automotive Frames.

Unit-II

Transmission: Clutches; Requirements and its types, Gear Box: Need and requirements, Types of manual gear boxes, Gearratio Calculation.

Drive Line: Propeller Shaft; Design Considerations & Constructional Details, Universal Joints, Constant Velocity Joints, Hotchkiss Drive, Torque Tube Drive, Radius Rods and Stabilizers, Final drive ;Different types, Multi; axle Vehicles, Differential; Working PrincipleandConstructionalDetails,Non–SlipDifferential,Differential Locks.

Unit-III

Suspension System: Need; factors influencing ride comfort; types; suspension springs; leaf spring, coil spring &torsion bar; spring materials; independent suspension; rubber suspension; pneumatic suspension; hydraulic suspension, shock absorbers; liquid & gas filled.

Braking Systems: Stopping Distance, Braking Efficiency, Weight Transfer during Braking, Drum Brakes ;Constructional Details, Leading and Trailing Shoe, Braking Torque, Disc Brake ; Types and Constructional Details, Hydraulic Braking System, Pneumatic Braking System, Power–Assisted Braking System, Factors affecting brake performance, operating temperature, Area of brake lining, clearance.

Unit-IV

Axles: Live and Dead Axles, Constructional Details, Different Types of Loads acting on Drive Axles, Rear Axle Shaft Supporting Types: Semi Floating, Full Floating, Three Quarter Floating, Axle Housings and Types

Steering System: Types of Front Axles and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion of Wheels during Steering, Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over Steer and Under Steer, Reversible and Irreversible Steering, Hydraulic Power Assisted Steering, Turning Radius Calculation.

Unit-V

Wheels and Tyres: Types of Wheels, Construction, Structure and Function, Forces acting on wheels, Wheel Dimensions, Wheel Balancing, and Wheel Alignment. Structure and Function of Tyres, Static and Dynamic Properties of Pneumatic Tyres, Types of Tyres, Materials, Tyre Section & Designation, Factors affecting Tyre Life, Tyre Rotation.

Bearings:Functions;classificationofbearings;bearingmaterials;automotivebearings.

Recent Trends in Chassis Systems: Special Steering Columns, 4 wheel steering system, Electric PowerSteering,Anti–LockBrakingSystem,TractionControlSystems,ElectronicBrakeforceDistributionSystems, Corner Stability Control, Hill Assist, and Autonomous Braking System.

Text Books:

1. Automobile engineering", Dr. Kripal Singh.
2. Automobile engineering" R. B. Gupta, Satya Prakashan.

References:

1. Heldt P. M.," Automotive chassis", Chilton Co., New York.
2. Giles J. G., "Steering, Suspension and tyres" ,I liffe Book Co., London.
3. A. K. Babu, Automotive Mechanics, Khanna Publishing House

Refrigeration & Air Conditioning

Objective:

- The main objective of refrigeration and air conditioning is to control the temperature, humidity, and air quality of an enclosed space.
- Refrigeration involves removing heat from a space to lower its temperature and preserve or extend the shelf life of perishable goods.
- Controlling the temperature and humidity of the air inside a building or vehicle to create a comfortable and healthy indoor environment.

SubjectCode:BTME-601	Refrigeration & Air Conditioning	L TP:3 1 0	Credits:4

The students will be able to	
CO1	Understand the basics concepts of Refrigeration &Air; Conditioning and its future prospects.
CO2	Explain the construction and working of various components in Refrigeration & Air; Conditioning systems.
CO3	Understand the different types of RAC systems with their respective applications.
CO4	Apply the basic laws to the thermodynamic analysis of different processes Involved in Refrigeration and Air; Conditioning.
CO5	Apply the basic concepts to calculate the COP and other performance parameters for different RAC systems
CO6	Analyze the effects of performance parameters on COP.

Unit-1 **8Hours**

Refrigeration:

Introduction to refrigeration system, Methods of refrigeration, Unit of refrigeration, Refrigeration effect, Carnot refrigeration cycle, Refrigerator and Heat Pump, C.O.P.

Air Refrigeration cycle:

Open and closed air refrigeration cycles, Reversed air Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Need of Aircraft refrigeration, Classification of aircraft refrigeration system. Boots trap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

Unit-2 **8Hours**

Vapour Compression System:

Reversed vapour Carnot cycle, limitation of Reversed vapour Carnot cycle, Simple vapour compression cycle, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle,

Multistage System:

Multistage vapour compression system requirement, Different configuration of multi pressure system, Removal of flash gas, Intercooling, Multi evaporator system, Cascade system.

Unit-3 **8Hours**

Vapour Absorption system;

Working Principal of vapour absorption refrigeration system, Comparison between absorption &compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium; Bromide water vapour absorption system, Comparison, Three fluid system.

Refrigerants:
Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants,Secondaryrefrigerants,andEnvironmentfriendlyrefrigerants,Anti-freezesolution,Phasechangingmaterials,Ozonelayerdepletionandglobalwarmingconsiderationsofrefrigerants,Selectionofrefrigerants,Future Refrigerants like Hydrofluoro ;Olefines

Unit-4 **8Hours**

Air Conditioning:
Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart,DifferentPsychrometricprocesses,AirWashers,Coolingtowers&humidifyingefficiency,Thermalanalysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside& outside design conditions, Heat transfer through walls & roofs, Infiltration &ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor(GSHF),Apparatus dew point (ADP).

Window air Conditioner, Simple air conditioning system, Air conditioning system with ventilation.

Unit-5 **8Hours**

Refrigeration System Equipment:
Compressors, Condensers, Expansion Devices and Evaporators, Elementary knowledge of transmission and distribution of air through ducts and fans,

Application:
Food preservation, Transport refrigeration, Cold storage, Refrigerates Freezers, Iceplant, Water coolers, Comfort and Industrial air conditioning Refrigeration.

Other systems:
Cryogenic liquefy action and refrigeration systems, Brief introduction of Thermo; electric refrigeration system, Steam jet refrigeration system, Vortex tube refrigeration system, Magnetic refrigeration system.

Reference Books:

1. Refrigeration and Air conditioning by C.P Arora, Mc Graw; Hill
2. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd. Pub.
3. Refrigeration and Air conditioning by R.C .Arora, PHI
4. Principles of Refrigeration by Roy J .Dossat. Pearson Education
5. Refrigeration and Air conditioning by Stoecker&Jones.Mc Graw; Hill
6. Refrigeration and Air conditioning by Arora & Domkundwar. Dhanpat Rai
7. Thermal Environment Engineering. By Kuhen, Ramsey & Thelked

Machine Design

Objective:

- The main objective of machine design is to create a machine or mechanical system that can perform a specific task efficiently, reliably, and safely.
- This involves considering factors such as the intended use of the machine, its operating environment, its power source, the materials and manufacturing methods used in its construction, and any relevant safety regulations or standards.
- In addition, the design process typically involves creating detailed drawings or computer models of the machine, as well as conducting simulations or prototypes to test and refine the design before it is finalized.

SubjectCode:BTME-602	Machine Design	L TP:3 1 0	Credits:4

Course Outcomes: The student will be able to	
CO1	Recall the basic concepts of Solid Mechanics to understand the subject.
CO2	Classify various machine elements based on their functions and applications.
CO3	Apply the principles of solid mechanics to machine elements subjected to static and fluctuating loads.
CO4	Analyze forces, bending moments, twisting moments and failure causes in various machine elements to be designed.
CO5	Design the machine elements to meet the required specification.

Unit-I **8Hours**

Introduction

Definition, Design requirements of machine elements, Design procedure, Standards in design, Standards designation of carbon & alloy steels, Selection of preferred sizes, Selection of materials for static and fatigue loads, Design against Static Load

Design against Fluctuating Loads

Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Design for finite & infinite life, Soderberg, Goodman, Gerber criteria

Unit-II **8Hours**

Riveted Joints

Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint

Welded Joints

Stress relieving of welded joints, Butt Joints, Fillet Joints, Strength of Butt Welds, and Strength of parallel fillet welds, Strength of transverse fillet welds

Shafts

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigueloads,Designforrigidity,Keys,Typesofkeys,Selectionofsquareandflatkeys,Strengthofsunkkey

Unit-III **8Hours**

Spur Gears

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash,SelectionOfgearmaterials,Gearmanufacturingmethods,Designconsiderations,Beamstrengthofgeartooth,Dynamictoothload,Wearstrengthofgeartooth,Failureofgeartooth,Designof spur gears, AGMA and Indian standards.

Helical Gears
Terminology, Proportions for helical gears, Force components on a tooth of helical gear, Virtual number of teeth, Beam strength and wear strength of helical gears, Dynamic load on helical gears, Design of helical gears.

Introduction, Classification and Applications of Bevel& Worm Gears

Unit-IV **8Hours**

Sliding Contact Bearing
Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing.

Rolling Contact Bearing
Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing.

Unit-V **8Hours**

IC Engine Parts
Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin;

Friction Clutches
Clutches, Difference between coupling and clutch, Single plate friction clutch, Torque transmitting capacity,Multi-Disk Clutches, Friction Material

Note: Design data book is allowed in the examination

Text Books:

1. Design of Machine Elements; V. B. Bhandari, Mc Graw Hill Co.
2. Design of Machine Elements, Sharma and Purohit, PHI.

Reference Books:

1. MechanicalEngineeringDesign,9e–JosephE.Shigely,McGrawHillEducation.
2. Machine Design; Maleev and Hartman, CBS Publishers.
3. Design of Machine Design; M. F. Spott, Pearson Education.
4. Elements of Machine Component Design, Juvinal &Marshek, John Wiley &Sons.
5. Machine design, Robert L. Norton, Pearson Education
6. Theory& Problem of Machine Design (Schaum's Outline Series) Hall, Holowenko, Laughlin, Tata Mc Graw Hill Co.
7. Machine Design; Sharma and Agrawal, S. K. Kataria & Sons.
8. Machine Design, U C Jindal, Pearson Education.

Theory of Machines

Objectives:

- The main objective of the theory of machine is to study the behavior and properties of machines, particularly abstract machines or computational models, such as Turing machines, finite automata, pushdown automata, and others.
- It provides a mathematical framework for analyzing the capabilities and limitations of different types of machines, and helps in understanding the fundamental principles of computation.
- By understanding the theory of machines, computer scientists and engineers can design and develop more efficient algorithms and computational systems, and solve complex computational problems.

SubjectCode:BTME-603	Theory of Machines	L TP:3 1 0	Credits:4

Course Outcomes: The students will be able to	
CO1	Understand the principles of kinematics and dynamics of machines.
CO2	Calculate the velocity and acceleration for 4-bar and slider crank mechanism
CO3	Develop camprofile for followers executing various types of motions
CO4	Apply the concept of gear, gear train and fly wheel for power transmission
CO5	Apply dynamic force analysis for slider crank mechanism and balance rotating& reciprocating masses in machines.
CO6	Apply the concepts of gyroscope, governors in fluctuation of load and brake& Dynamometer in power transmission

Unit-I **(09Hours)**

Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain.

Velocity analysis: Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, instantaneous center.

Acceleration analysis: Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism,.

Unit-II **(10Hours)**

Cams: Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration

Gears and gear trains: Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.

Unit-III **(08Hours)**

Force analysis: Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link in plane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turning moment on crankshaft due to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi; cylinder engines, Fluctuation of speed, Flywheel.

Unit-IV **(09Hours)**

Balancing: Introduction,staticbalance,dynamicbalance,balancingofrotatingmasses,twoplanebalancing,graphicalandanalyticalmethods,balancingofreciprocatingmasses,balancingofsinglecylinderengine.

Governors: Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Effort and Power of governor

Unit-V **(09Hours)**

Brakes and dynamometers: Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer

Gyroscope: Space motion of rigid bodies, angular momentum, gyroscopic couples, gyroscopic stabilization, shipstabilization, stability of four wheel and two wheel vehicles moving on curved paths.

Text/Reference Books

1. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson.
2. Theory of Mechanisms and Machines: Amitabh Ghosh and Ashok Kumar Mallik, third Edition Affiliated East; West Press.
3. TheoryofMachinesandMechanisms:JosephEdwardShigleyandJohnJosephUicker,Jr.OxfordUniversityPress
4. Kinematics and dynamics of machinery: R L Norton, Mc Graw Hill
5. Theory of Machines: S. S. Rattan, Mc Graw Hill
6. Theory of Machines: Thomas Bevan, CBS Publishers.

Suggested Software

Mech Analyzer

Refrigeration &Air Conditioning Lab

Objective:

- The main objective of a Refrigeration & Air Conditioning Lab is to provide hands-on training to students and professionals in the fields of refrigeration and air conditioning.
- The lab is typically equipped with various types of equipment, such as refrigeration cycles, air conditioning units, and heat pumps, that allow students to learn about the fundamental principles of refrigeration and air conditioning.
- The lab also provides a platform for students to develop practical skills, such as system design, installation, troubleshooting, and maintenance of refrigeration and air conditioning systems.

SubjectCode:BTME-651P	Refrigeration &Air Conditioning Lab	L TP:0 0 2	Credits:1

The students will be able to:	
CO1	Determine the performance of different refrigeration and air-conditioning systems.
CO2	Apply the concept of psychrometry on different air cooling systems.
CO3	Interpret the use of different components, control systems and tools used in RACsystems
CO4	Demonstrate the working of practical applications of RAC systems.

Minimum eight experiments out of the following:

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. Experiment on air; conditioning test rig & calculation of various performance parameters.
3. Study of Psychrometer and determination of humidity of air using Sling Psychrometer.
4. To study and perform experiment on vapour absorption apparatus.
5. To studytheairwasherandperformdifferentpsychometricprocessesonairwasher.
6. Study ofdesertcoolersanddeterminethechangeintemperatureandhumidityofambientair.
7. Handling, use and familiarization with refrigeration tools and accessories such asTube cutter; Tubebender [springtype]; Flaring tool; Swaging tool; Pinch off etc.
8. Study of window air conditioner.
9. Study of Hermetically sealed compressor.
10. Tostudybasiccomponentsandcontroldevicesofrefrigerationandair-conditioningsystem.
11. Experiment on Ice; plant and calculation of various performance parameters.
12. Visit of a central air conditioning plant and its detailed study.
13. Visit of cold; storage and its detailed study.

Machine Design Lab

Objective:

- The main objective of a machine design lab is to provide students with hands-on experience in designing, analyzing, and testing mechanical systems and components.
- The lab typically focuses on practical aspects of mechanical design, such as using CAD software, designing machine elements such as gears, bearings, and shafts, and performing experiments to validate design concepts.

By completing projects in the lab, students can develop their problem-solving skills, enhance their understanding of mechanical principles, and gain valuable experience in project management and teamwork.

SubjectCode:BTME-652P	Machine Design Lab	L TP:0 0 2	Credits:1

Course Outcomes: The student will be able to	
CO-1	Apply the principles of solid mechanics to design various machine Elements subjected to static and fluctuating loads.
CO-2	Write computer programs and validate it for the design of different machine elements
CO-3	Evaluate designed machine elements to check their safety.

A Design of Machine Elements

1. Design a knuckle joint subjected to given tensile load.
2. Design a riveted joint subjected to given eccentric load.
3. Design of shaft subjected to combined constant twisting and bending loads
4. Design a transverse fillet welded joint subjected to given tensile load.
5. Design &select suitable Rolling Contact Bearing for a shaft with given specifications
6. Design a cylinder head of an IC Engine with prescribed parameters.
7. Design of Piston &its parts of an IC Engine

B. Computer Programs for conventional design

Computer and Language

Students are required to learn the basics of computer language such as C/C++/MATLAB so that they should be able to write the computer program.

1. DesignapairofSpurGearwithgivenspecificationstodetermineitsvariousdimensionsusing ComputerPrograminC/C++ .
2. Design a pair of Helical Gear with given specifications to determine its various dimensions using Computer Program in C/C++.
3. DesignofSlidingContactBearingwithgivenspecifications&determineitsvariousparametersusing ComputerPrograminC/C++ .

SubjectCode:BTME-653P	Theory of Machines Lab	L TP:0 0 2	Credits:1

The students will be able to:	
CO1	Demonstrate various mechanisms, their in versions and brake and clutches in automobiles
CO2	Apply cam-follower mechanism to get desired motion of follower.
CO3	Applytheconceptsofgearsandgeartraintogetdesiredvelocityratioforpower transmission.
CO4	Apply the concept of governors to control the fuel supply in engine.
CO5	Determine the balancing load in static and dynamic balancing problem

List of Experiments

(Minimum eight experiments out of the following)

NOTE: Student has to write computer program in C/C++/Python and to run to compute the output values for at least ONE experiments.

1. To study various types of kinematics links, pairs, chains &Mechanisms
2. To study Whitworth Quick Return Motion Mechanisms, Reciprocating Engine Mechanism, and Oscillating Engine Mechanism
3. To study of in versions off our bar linkage
4. To study of in versions of single/double slider crank mechanisms
5. Tostudyvarioustypesofgear(Helical,crosshelical,worm,bevelgear)andgearprofile(involuteandcycloidal)andconditionf or interference Helical, cross helical, worm, bevel gear
6. To compute the out put velocity in various gear trains
7. To study gyroscopic effects through models
8. To determine gyroscopic couple on Motorized Gyroscope
9. To perform experiment on dead weight type governor to prepare performance characteristic Curves, and to find stability &sensitivity
10. To perform experiment on spring controlled governor to prepare performance characteristic Curves, and to find stability &sensitivity
11. To determine whirling speed of shaft theoretically and experimentally
12. To perform the experiment for static/dynamic balancing
13. To perform experiment on brake
14. To perform experiment on clutch
15. To perform the experiment for static/dynamic balancing.
16. To perform experiment on longitudinal vibration
17. To perform experiment on transverse vibration

Semester–VI: Departmental Elective–III: Non destructive Testing

Subject Code:BTME-604	Non destructive Testing	L TP:3 0 0	Credits:3

Course Outcome: Student will be able to	
CO1	Understand the concept of destructive and Non-destructive testing methods.
CO2	Explaintheworkingprincipleandapplicationofdiepenetranttestandmagnetic Particle inspection.
CO3	Understand the working principle of eddy current inspection.
CO4	Apply radio graphic techniques for testing.
CO5	Apply the principle of Ultrasonic testing and applications in medical and engineering areas.

Unit-I:

Introduction to NDT, DT, advantages & limitations of NDT, classification of NDT methods, Comparison with DT, Terminology, Flaws and Defects. Scope of NDT. Codes, Standards and Certifications in NDT.

Visual Inspection– Equipment used for visual inspection, Borescopes, Application of visual inspection tests in detecting surface defects and their interpretation, advantages & limitations of visual inspection, Visual Inspection in Welding.

Unit-II:

Liquid Penetrant Testing–Principle, Scope, Testing equipment, Advantages, Limitations, types of penetrants and developers, standard testing procedure, Zyglo test, Illustrative examples and interpretation of defects.

Magnetic Particle Inspection – Principle, Scope, Testing equipment, Advantages, Limitations, Application of MPI & standard testing procedure, DC & AC magnetization, Skin Effect, different methods to generate magnetic fields, Illustrative examples and interpretation of defects.

Unit-III:

Radio graphic Testing– Introduction to electromagnetic waves and radioactivity, various decays, Attenuation of electromagnetic radiations, Photo electric effect, coherent scattering and Incoherent scattering, Beam geometry.

X-ray Radiography – Principle, equipment & methodology, applications, source, types of radiations and limitations; γ-ray Radiography – Principle, equipment, γ-ray source & technique; Radiography Image Quality Indicators, Film Processing, advantages of γ-ray radiography over X-ray radiography. Precautions against radiation hazards.

Unit-IV:

Ultrasonic Testing–Introduction, Principle, Piezoelectricity and Piezoelectric Transducers, Wave propagation, Ultra sonic probes, selection of angle probes, Acoustic Impedance, Reflection and transmission coefficient, Snell's law, standard testing procedure & calibration, advantages & limitations.Datarepresentation-A;scan,B-scan,C-scan.Applications in inspection of welded joints, castings, forgings and dimensional measurements. Introduction to TOFD & Phased Array Ultrasonic Testing.

Unit- V:

Special NDT Techniques:

Eddy Current Inspection–Introduction, Principle, Methods ,scope, Equipment, types of probes, Sensitivity ,standard testing procedure, advanced ECT methods, advantages and limitations.

Acoustic Emission Technique–Introduction, Types of AE signal, Principle, Advantages & Limitations, Interpretation of Results, Applications.

Holography, Thermography–Introduction, Principle, advantages, limitations and applications.

Books and References:

1. Non-DestructiveTestingandEvaluationofMaterials,by;Prasad,McGrawHillEducation.
2. PracticalNon-destructiveTesting,by;BaldevRaj,T.Jayakumar,M.Thavasimuthu,WoodheadPublishing.
3. Non-DestructiveTestingTechniques,by;RaviPrakash,NewAgeInternational.
4. Non-destructive Testing Hand book, by Robert C. Mc Master, American Society for Non-destructive.

5. Introduction to Non destructive Testing: A Training Guide, by; Paul E. Mix, wiley.
6. ElectricalandMagneticMethodsofNon-destructiveTesting,by;J.Blitz,springer.
7. Practical non destructive testing by Raj, Baldev.
8. Basics of Non-Destructive Testing, by Lari& Kumar, KATSON Books.
9. ASMESec. V, boiler and pressure vessel code

Semester–VI: Departmental Elective–III: Artificial Intelligence

Subject Code: BTME-605	Artificial Intelligence	L TP:3 0 0	Credits:3

Course Outcomes: Students are able to	
CO1	Understand concepts of Artificial Intelligence
CO2	Solve problem by Search-I& Search-II
CO3	Understand Knowledge representation
CO4	Apply concepts of Learning methods
CO5	Analyse Decision Networks
CO6	Build planning graphs

Unit1: **(9Hours)**

Introduction of Artificial Intelligence, Intelligent Agents, and Behaviors of Artificial Agents, Structure of Intelligent Agents. Problem solving and state space search, Uninformed Search, Heuristic search, Best; First Search, Heuristic Functions, Constraints satisfaction problem, Iterative Improvement Algorithms.
(Recommended lab practice sessions: Games as Search Problems, Alpha-Beta Pruning, State; of; the; Art Game Programs.)

Unit2: **(8Hours)**

Introduction to Knowledge Representation, Propositional Logic,1storder logic-I,1storderlogic-II,Inference in First-Order Logic, Using First-Order Logic, Building a Knowledge Base, Logical Reasoning Systems; Indexing, Retrieval, and Unification, Inference in FOL-II, Answer Extraction.

Unit3: **(9Hours)**

Procedural control of reasoning, reasoning under uncertainty, Bayesian Networks, Decision Networks, Uncertain knowledge and reasoning, The Axioms of Probability, Bayes' Rule and Its Use, Probabilistic Reasoning Systems, Making Simple Decisions, Making Complex Decisions, Introduction to Planning, Practical Planning and Acting, Inductive Learning, Learning from Observations.

Unit4: **(7Hours)**

Neural Networks: Learning in Neural Networks, How the Brain Works, Perceptron, Multilayer Feed; Forward Networks, Applications of Neural Networks, Introduction to Learning, Kinds of Learning, Supervised and Unsupervised Learning, Clustering, Reinforcement Learning.

Learning a Function, Aspects of Function Learning, and Types of function learning aspects: Memory, Averaging and Generalization, Example problems based on Function Learning. Learning methods, Nearest Neighbor, Decision Trees, and Neural Networks.

Unit5: **(7Hours)**

Intelligent Agents, Types of Communicating Agents, A Communicating Agent, Practical Natural Language Processing: Practical Applications, Efficient Parsing, Scaling Perception: Image; Processing Operations for Early Vision, Using Vision for Manipulation and Navigation, Speech Recognition. Robotics: Tasks: What

Are Robots Good For? Parts: What Are Robots Made Of? Architectures, Configuration Spaces: A Frame work for Analysis, Navigation and Motion Planning

Text Book:

1. StuartRussell,PeterNorvig,"ArtificialIntelligence–AModernApproach",PearsonEducation

Reference Books:

2. Elaine Rich and Kevin Knight, "Artificial Intelligence",Mc Graw;Hill
3. ECharniakandDMcDermott,"IntroductiontoArtificialIntelligence",PearsonEducation
4. DanW.Patterson,"ArtificialIntelligenceandExpertSystems",PrenticeHallofIndia,

Semester–VI: Departmental Elective–III: Tribology

Subject Code: BTME-606	Tribology	L TP:3 0 0	Credits:3

Course Outcome: Student will be able to	
CO1	Identify and explain various friction and wear mechanisms.
CO2	Select proper lubricants for different applications.
CO3	Select suitable lubrication methods in different bearings.
CO4	Study the surfaces coating techniques for reduction of wear.
CO5	Analyze the impact of friction in various kinematic pairs.

UNIT–I Lubrication and Lubricants

Introduction to tribology, tribology in industry, basics modes of lubrication, oil viscosity, temperature and pressure dependence of viscosity, Viscosity index, viscosity measurement, properties of lubricants, temperature characteristics of lubricants, lubricant impurities and contaminants, mineral oils based lubricants, synthetic oils based lubricants, emulsions and aqueous lubricants, greases, and lubricant additives.

UNIT–II Friction and Wear

Friction; causes of friction, theories of dry friction; adhesion theory, abrasive theory, junction growth theory, laws of rolling friction, friction measurement, friction instabilities. Wear; classification; abrasive wear, erosive wear, cavitation wear, adhesive wear, corrosive wear, oxidative wear, fatigue wear, factors affecting wear, measurement of wear, theories of wear, approaches to friction control and wear prevention.

UNIT–III Lubrication of Bearings

Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, jet lubrication, mistlubrication,lubricationutilizingunderracepassage,conceptofjournalbearing,minimumoilfilmthickness,porousbearings,flatplatethrustbearing,tiltingpadbearings,hydrostaticlubrication,squeezefilmlubrication,elasto;hydrodynamiclubrication,rollingelement bearings,gaslubricatedbearings,andhybrid bearings.

UNIT–IV Solid Lubrication and Surface Treatment

Lubrication by solids, friction and wear characteristics of lamellar solids, reduction of friction by soft metallic films, deposition methods of solid lubricants, techniques for producing wear resistant coatings, characteristics of wear resistant coatings.

UNIT–V Friction, Lubrication and Wear in Kinematic pairs

Theconceptoffrictionangle,frictionstability,frictioninslideways,frictioninscrewswithsquarethreads, friction in screws with triangular threads, mechanism and operation of plate clutch, cone clutch, rim clutch, centrifugal clutch, and belt drives, tribo design aspects of labyrinth seals, analysis of line contact lubrication, analysis of point contact lubrication, cam follower system, traction in the contact zone, and hysteresis losses.

Books and References:

1. FundamentalsofEngineeringTribologywithApplicationsbyHarishHirani,CambridgeEnglish(2017)
2. AppliedTribology(BearingDesignandLubrication),byMichaelMKhonsari,JohnWiley&Sons(2001).
3. PrinciplesofTribology,byJHalling,TheMacmillanPressLtd,London,(1975).
4. Friction,Wear,Lubrication:AtextbookinTribology,byLudemaKC,CRCPress,(2010).
5. FundamentalsofMachineElements,B.J.Hamrock,B.O.Jacobson&S.R.Schmid,McGraw;HillInc.,(1998).
6. Fundamentals of Mechanical Component Design, by K.S. Edwards &R. B. McKee, Mc Graw; HillInc.,(1991).
7. MechanicalEngineeringDesignbyJ.E.ShigleyandCRMischke,TataMcGraw;HillPublishingCompanyLimited, (2003).
8. Tribo physics, by N.P.Suh Prentice; Hall,(1986).
9. Friction,Wear,Lubrication:ATextbookinTribology,byKennethCLudema,LayoAjayi,CRCPress(2019).

Semester–VI: Departmental Elective–III: Gas Dynamics and Jet Propulsion

Subject Code:BTME-607	Gas Dynamics and Jet Propulsion	L TP:3 0 0	Credits:3

Course Outcomes: The students will be able to	
CO1	Understand the concept of compressible fluid flow and flow through variable Area ducts.
CO2	Understand the basic principle and types of jet and rocket propulsion.
CO3	Apply the basic laws for the investigation of flow through ducts.
CO4	Apply the basic laws for the thermodynamics analysis of jet and rocket propulsion.
CO5	Analyze the compressible flow through variable area ducts.

UNIT-I:
Compressible flow, definition, Machwaves and Machcone, stagnation states, Mass, momentum and energy equations of one-dimensional flow.

UNIT-II:
Isentropic flow through variable area ducts, nozzles and diffusers, subsonic and supersonic flow variable area ducts, choked flow, Area; Machnumber relations for isentropic flow.

UNIT-III:
Non-isentropic flow in constant area ducts, Rayleigh and Fano flows, Normal shock relations, oblique shock relations, isentropic and shock tables.

UNIT- IV:
Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turbo prop engines.

UNIT-V:
Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, spaceflights.

Books and References:

1. Ahmed F. El; Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008.
2. H.S.Mukunda,"UnderstandingAerospaceChemicalPropulsion",InterlinePublishing,2004.
3. HillP. and Peterson C., Mechanics &ThermodynamicsofPropulsion,AddisonWesley,1992.
4. Zucrow N. J., Aircraft and Missile Propulsion,Vol.I&II,JohnWiley,1975.
5. Sutton G. P., Rocket Propulsion Elements, John Wiley, New York, 1986.

Semester–VI: Departmental Elective–III: Automotive Electrical and Electronics

Subject Code:BTME-608	Automotive Electrical and Electronics	L TP:3 0 0	Credits:3

The students will be able to	
CO-1	Understand the basic concepts of electrical systems used in automobile.
CO-2	Understandtheconstructionalfeaturesofchargestoragedevicesandmethodstotestthese devices for their healthy operation.
CO-3	Understandtheprinciplesandcharacteristicsofchargingandstartingsystemofautomobileandstudythe various faults occurring in system.
CO-4	Understand the ignition and auxiliary system; types &constructional features used in automobile.
CO-5	Describe the principles and architecture of electronics systems and its components present in an automobile related to data transfer, instrumentation, control, and security systems.
CO-6	Understand latest trends developed in electrical and electronic systems of automobile and their advantages over conventional technologies.

Unit1 **[L 8Hours]**

Introduction to electrical fundamentals – Ohm's Law, Kirchhoff's Law, Capacitance and Inductance, Simple Electric Circuits, Automotive Wiring Harnesses, Insulated and Earth Return System, Positive and Negative Earth Systems, Connectors and its types

Charge storing devices: Principle and construction of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal, Hybrid Battery, Sodium Sulphur Battery and Aluminum Air Battery; Choice of Batteries for automotive applications, Characteristics of Battery, Battery Rating, Capacity and Efficiency, Various Tests on Battery, Battery– Charging Techniques. Maintenance of batteries.

Unit2 **[L 8Hours]**

Starter Systems: Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids.

Charging system components, Generators and Alternators, types, construction and Characteristics,

Charging System: Voltage and Current Regulation, Cut–out relays and regulators, Charging circuits for D.C. Generator , A. C. Single Phase and Three–Phase Alternator

Unit3 **[L 8Hours]**

Automotive Ignition Systems: Spark Plugs, Constructional details and Types, Battery Coil and Magneto–Ignition System Circuit details and Components, Centrifugal and Vacuum Advance Mechanisms, Non–Contact–type Ignition Triggering devices, Capacitive Discharge Ignition, Distributor–less Ignition Systems

Auxiliary Systems: Head Lamp and Indicator Lamp construction and working details, Focusing of headlamps,Anti–DazzlingandDipperDetails,AutomotiveWiringCircuits.Indicatorsandmeters,speedometers,electric horn, wind shield wiper, electrichornan drelay devices.

Unit4 **[L 8Hours]**

Automotive Electronics: Automotive networking, Bus system, Advantages of bus systems, requirements of buses, Buses in motor vehicle: CAN, Flex Ray, LIN, Ethernet, IP, PSI5, MOST bus and optical fibers/wave guides, Architectures of electronic system.

Control Units: ECM, ABS control unit, Steering Control Unit, SRS control unit, Automatic Air Conditioning Control Unit.

Unit5 **[L 8Hours]**

Automotive Sensors and Actuators: Basic principle, Main requirements, Micro mechanics, Position sensors, Speed and RPM sensors, Acceleration and vibration sensors, Pressure sensors, Flow meters, Gassensors,concentrationsensors,temperaturesensors,Forcesensors,Optoelectronicssensors,Sensorsfor driver assistance systems: Ultrasonic technology, Radar technology, LIDAR sensors Purge Control, Idling Setting Control, Immobilizer System, Stepper motors.

Books:

1. Automotive Electricals by PLKohli, Mc Graw Hill Publications.
2. Robert Bosch"Automotive Hand Book", SAE (8thEdition),2011.

References:

1. TomDenton,"AutomobileElectricalandElectronicSystems"4thedition;Routledge;2012.
2. BarryHollembeak,"AutomotiveElectricityandElectronics",DelmarCengageLearning;5thedition,2011