SREE VIDYANIKETHAN ENGINEERING COLLEGE
(AUTONOMOUS)
SreeSainath Nagar, A. Rangampet, Tirupati – 517 102

**DEPARTMENT OF MECHANICAL ENGINEERING**

**Supporting Document for 1.1.2**

# Syllabus Revision carried out in 2019

## Program: B.Tech.-Mechanical Engineering

## Regulations: SVEC-19

*This document details the following:*

1. Courses where syllabus has been changed 20% and more.
2. Course-wise revised syllabus with changes highlighted.

**Note:** *For SVEC-19 revised syllabus, SVEC-16 (previous syllabus) is the reference.*

# List of Courses where syllabus Content has been changed (20% and more)

| S. No. | Course Code | Name of the course | Percentage of Content changed | Page Number in which Details are Highlighted |
|---|---|---|---|---|
| 1. | 19BT40305 | Thermal Engineering-I | 40 | 4 |
| 2. | 19BT10201 | Basic Electrical and Electronics Engineering | 100 | 9 |
| 3. | 19BT10231 | Basic Electrical and Electronics Engineering Lab | 100 | 11 |
| 4. | 19BT1AC01 | Spoken English | 100 | 13 |
| 5. | 19BT1BS02 | Biology for Engineers | 100 | 15 |
| 6. | 19BT1HS01 | Communicative English | 20 | 17 |
| 7. | 19BT1BS04 | Engineering Chemistry | 50 | 19 |
| 8. | 19BT1BS32 | Engineering Chemistry Lab | 25 | 26 |
| 9. | 19BT2BS02 | Applied Physics | 100 | 29 |
| 10. | 19BT2BS31 | Applied Physics lab | 100 | 31 |
| 11. | 19BT2BS01 | Transformation Techniques and Linear Algebra | 20 | 33 |
| 12. | 19BT4BS01 | Material Science | 100 | 37 |
| 13. | 19BT4HS05 | Gender & Environment | 100 | 39 |
| 14. | 19BT4HS09 | Life Skills | 100 | 41 |
| 15. | 19BT4HS11 | Professional Ethics | 100 | 43 |
| 16. | 19BT4HS12 | Women Empowerment | 100 | 45 |
| 17. | 19BT40107 | Sustainable Engineering | 100 | 47 |
| 18. | 19BT50409 | Green Technologies | 35 | 49 |
| 19. | 19BT50301 | Computer Aided Design and Manufacturing | 20 | 53 |
| 20. | 19BT50303 | Thermal Engineering -II | 40 | 57 |
| 21. | 19BT50304 | Automobile Engineering | 20 | 61 |
| 22. | 19BT50305 | Compressible Fluid Flow | 100 | 65 |
| 23. | 19BT50307 | Statistical Inference and Modeling | 100 | 67 |
| 24. | 19BT50505 | Ethical Hacking | 100 | 69 |
| 25. | 19BT51207 | AI in Healthcare | 100 | 71 |
| 26. | 19BT40307 | Management Science | 100 | 73 |
| 27. | 19BT50310 | Artificial Intelligence and Robotics | 20 | 75 |
| 28. | 19BT50311 | Automotive Electronics | 100 | 79 |
| 29. | 19BT50312 | Industrial Automation and Control Systems | 100 | 81 |
| 30. | 19BT50314 | Programmable Logic Controller in Automation | 100 | 83 |
| 31. | 19BT50315 | Soft Computing Techniques in Mechanical Engineering | 100 | 85 |
| 32. | 19BT503AC | Foundations of Entrepreneurship | 100 | 87 |
| 33. | 19BT60301 | Industrial Engineering and Management | 20 | 89 |
| 34. | 19BT60304 | Casting and Welding Technology | 100 | 93 |
| 35. | 19BT60305 | Composite Materials | 100 | 95 |
| 36. | 19BT60307 | Internal Combustion Engines | 40 | 97 |

| S. No. | Course Code | Name of the course | Percentage of Content changed | Page Number in which Details are Highlighted |
|---|---|---|---|---|
| 37. | 19BT60310 | Automotive Fuels and Combustion | 100 | 101 |
| 38. | 19BT60311 | Design of Pressure Vessels and Piping Systems | 100 | 103 |
| 39. | 19BT60312 | Mechanical Behavior of Materials | 100 | 105 |
| 40. | 19BT60313 | Non Traditional Machining process | 100 | 107 |
| 41. | 19BT60314 | Optimization Techniques | 100 | 109 |
| 42. | 19BT50408 | Microelectromechanical Systems | 100 | 111 |
| 43. | 19BT60316 | Instrumentation and Control systems | 40 | 113 |
| 44. | 19BT60317 | Hydraulics and Pneumatics | 20 | 117 |
| 45. | 19BT60318 | Industrial Internet of Things | 100 | 121 |
| 46. | 19BT60319 | Machinery Fault Diagnosis and Signal Processing | 100 | 123 |
| 47. | 19BT61531 | Internet of Things Lab | 100 | 125 |
| 48. | 19BT70302 | Operations Management | 30 | 127 |
| 49. | 19BT70305 | Material Processing Techniques | 100 | 131 |
| 50. | 19BT70308 | Sustainable Manufacturing | 100 | 133 |
| 51. | 19BT70309 | Cryogenics | 30 | 135 |
| 52. | 19BT70310 | Design of Automotive components | 100 | 139 |
| 53. | 19BT70313 | Surface Engineering | 100 | 141 |
| 54. | 19BT70314 | Hybrid and Electric Vehicles | 100 | 143 |
| 55. | 19BT70331 | Industrial Automation and Robotics Lab | 80 | 145 |
| 56. | 19BT703AC | MATLAB for Mechanical Engineers | 100 | 147 |
| | | Average %**(A)** | 79.46 | - |
| | | Total No. of Courses in the Program **(T)** | 133 | |
| | | No. of Courses where syllabus (more than 20% content) has been changed **(N)** | 56 | |
| | | Percentage of syllabus content change in the courses **(C)=(A x N)/100** | 44.49 | |
| | | **Percentage of Syllabus Content changed in the Program (P)= C/T*100** | **33.45** | |

**DEAN (Academics)**

DEAN (Academic)
SREE VIDYANIKETHAN ENGINEERING COLLEGE
Sree Sainath Nagar, A. RANGAMPET
CHITTOOR (DT.)-517 102, A.P.

**PRINCIPAL**

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SREE VIDYANIKETHAN ENGINEERING COLLEGE
(AUTONOMOUS)
Sree Sainath Nagar, A. RANGA
Chittoor (Dist.) - 517 102, A.P.

**II B. Tech. – II Semester**

(19BT40305) **THERMAL ENGINEERING – I**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Engineering Thermodynamics.

**COURSE DESCRIPTION:**

Introduction to Internal Combustion (IC) engines; Components and working of 2-stroke and 4-stroke engines; Combustion phenomena in spark ignition and compression ignition engines; Performance parameters of an internal combustion engine; Gas turbines; Jet propulsions and Rocket propulsions; Reciprocating compressors; Rotary compressors; Concept of steam power cycles.

**COURSE OUTCOMES:**

On successful completion of this course, students will be able to:

CO1: Analyze the combustion process in IC engines and calculate the Performance parameters of IC Engines under various testing conditions.

CO2: Analyze the gas turbines and jet propulsions using PV and TS diagrams and solve problems on it.

CO3: Calculate the performance parameters of air compressors using principles of air compressors.

CO4: Analyze the steam power cycles using PV and TS diagrams and calculate the thermal efficiencies of these cycles.

**DETAILED SYLLABUS:**

**UNIT I: INTERNAL COMBUSTION ENGINES (10 Periods)**

Introduction, Classification of IC Engines, Engine components, Working of two stroke and four IC engines, Valve and port timing diagrams; Air-fuel and actual cycles; Combustion in Spark Ignition (SI) Engines - Stages of combustion in SI engines, Factors influencing the flame speed, Phenomenon of knock in SI engines; Combustion in Compression Ignition (CI) Engines - Stages of combustion in CI engines, Factor affecting delay period; Phenomenon of knock in C.I engine, comparison of knock in SI and CI engines.

**UNIT II: PERFORMANCE OF INTERNAL COMBUSTION ENGINES (9 Periods)**

Performance parameters - Brake power, indicated power, Friction power, Mean effective pressure, Specific fuel consumption, Engine efficiencies, Performance calculations, Heat balance sheet; Measurement of brake power; Measurement of indicated power; Measurement of Friction power - Willian's line method, Morse test, motoring test and retardation test; Air and fuel measurement.

**UNIT III: GAS TURBINES AND JET PROPULSIONS (9 Periods)**

**Gas Turbines:** Classification of Gas Turbines, Components of simple gas turbine plant-Ideal Gas Turbine Cycle and its deviations with actual cycle; Turbine Work and Efficiency of Simple Gas Turbine Cycle, Condition for Optimum Pressure Ratio, Methods to improve

Turbine Work - Inter cooling and Reheating; Methods to improve efficiency - Regeneration.

**Jet Propulsion:** Introduction, Classification of Jet Propulsion devices, Working of Air breathing engines- Turbojet Engine, Turbo Prop Engine, Ram Jet Engine and Pulse Jet Engine; Introduction to Rocket Engine.

**UNIT IV: AIR COMPRESSORS** **(9 Periods)**

Introduction, Classification, Reciprocating Compressors - Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, Single Stage and Multi Stage Compressors, Effect of Inter cooling and Pressure Drop in Multi - Stage Compressors; Rotary compressor - Working principles of Roots blower, Vane type Blower, Centrifugal Compressor, Axial Flow Compressors.

**UNIT V: STEAM POWER CYCLES** **(8 Periods)**

Carnot Cycle, Rankine Cycle-Schematic Layout, Thermodynamic Analysis; Effect of operating variables on the performance, Reheating and Regeneration, Modified Rankine Cycle; Low temperature power cycles, Binary vapour cycle and Cogeneration.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan.***

**TEXTBOOKS:**


1. R.K.Rajput, *Thermal Engineering*, Laxmi Publication, 9th Edition,2013.
2. V.Ganesan,*I.C.Engines*,TMH,3rd Edition,2010


**REFERENCE BOOKS:**


1. M.L. Mathur & R. P. Sharma, *Internal combustion engines*, Dhanpat Rai & Sons, 8th Edition, 2014.
2. R. S. Khurmi & J.S. Gupta, *Thermal Engineering*, S.Chand, 15th Edition, 2015.

## II B. Tech. – II Semester

## (16BT40305)THERMAL ENGINEERING-I

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | - | 3 |

**PRE-REQUISITES:** Course on Thermodynamics.

**COURSE DESCRIPTION:** Comparison of air-standard and actual cycles; Components and working of 2-stroke and 4-stroke engines; Combustion phenomena in spark ignition and compression ignition engines; Performance parameters of an internal combustion engine; Estimating heat losses in an engine; Components and working of reciprocating and rotary compressors.

**COURSE OUTCOMES:** On successful completion of this course, students will be able to:

CO1. Demonstrate the basic knowledge of an engine and air compressor in developing the analytical models.

CO2. Analyze the combustion and performance parameters of SI engines and CI engines and analyze the performance of air compressors.

CO3. Provide solutions in the design of IC engine.

CO4. Conduct investigation on IC engines for performance improvement and emission reduction.

CO5. Apply new combustion techniques to analyze the combustion in IC Engines.

**DETAILED SYLLABUS:**

**UNIT - I: I.C. ENGINES** **(09 Periods)**

Classification of I.C. Engines, engine components, Working of two stroke and four stroke engines, Comparison of two stroke and four stroke engines, comparison of SI and CI engines, Valve and port timing diagrams, application of I.C engines, Fuel air cycles **-**Composition of cylinder gases, variable specific heats, dissociation, number of moles Actual cycle - heat loss, time loss, exhaust blow down factors and loss due to rubbing friction.

**UNIT - II: COMBUSTION IN S.I. AND C.I. ENGINES**
**(10 Periods)**

**Combustion in S.I. Engines:** Stages of combustion in SI engines, Flame front propagation, Factors influencing the flame speed, Abnormal combustion, Phenomenon of knock in S.I engines, Combustion chambers for SI Engines, Fuel Requirements and Fuel Rating.

**Combustion in C.I. Engines:** Stages of combustion in C.I engines, Factor affecting delay period; Phenomenon of knock in C.I engine, comparison of knock in S.I and C.I engines, Combustion chambers for C.I engines, Fuel Requirements and Fuel Rating.

**UNIT - III: PERFORMANCE OF I.C. ENGINES (10 Periods)**

**Performance parameters**: Brake power, Indicated power, Friction power, Mean effective pressure, Engine efficiencies, Performance calculations, Heat balance.

**Measurement of Performance parameters:** Brake power **-** Rope brake, hydraulic, Eddy current and swinging field DC dynamometers; Measurement of Friction power - Willian's line method, Morse test, motoring test and retardation test; Air and fuel measurement.

**UNIT - IV: FUELS AND COMBUSTION (08 Periods)**

Introduction, Classification of fuels - Solid fuels, Liquid fuels, Gaseous fuels; Combustion equation, Theoretical air and excess air; Stoichiometric air fuel ratio, Air fuel ratio from analysis of product, Analysis of exhaust gas and flue gas, Internal energy and enthalpy formation, Determination of calorific values of fuels, Adiabatic flame temperature, Chemical equilibrium.

**UNIT - V: AIR COMPRESSORS (08 Periods)**

Air Compressors - Reciprocating Compressors, Effect of Clearance volume in Compressors, Volumetric Efficiency, Single Stage and Multi Stage Compressors, Effect of Inter cooling and Pressure Drop in Multi - Stage Compressors; Working principles of Roots blower, Vane type Blower, Centrifugal Compressor, Axial Flow Compressors.

**Total Periods: 45**

**TEXT BOOKS:**

1. V. Ganesan, *I.C. Engines*, TMH, 3rd Edition, 2008.

2. R.K.Rajput, *Thermal Engineering*, Laxmi publications, 8th Edition, 2010

**REFERENCE BOOKS:**

1. M.L Mathur & R.P.Sharma, *Internal combustion engines*, Dhanpat Rai & Sons, 8th Edition, 2014.

2. Mahesh M Rathore, *Thermal Engineering*, Tata Mcgrawhill Education, 2010.

**I B. Tech. – I Semester**

(19BT10201) **BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**

(Common to EEE, ECE, EIE, CSE (AI), CSE (DS) and CSBS)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:** --

**COURSE DESCRIPTION:** Principles of Electrical Systems; AC Machines; Semiconductor Devices and Op-Amps.

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1. Analyze electrical circuits by applying the conceptual knowledge of circuit elements.

CO2. Demonstrate knowledge on various generation technologies, protection devices, safety procedures and BEE standards.

CO3. Demonstrate knowledge on characteristics and applications of transformers and AC machines.

CO4. Demonstrate knowledge on characteristics and applications of diode, BJT and Op-amps.

**DETAILED SYLLABUS:**

**UNIT-I: Principles of Electrical Systems-I (9 Periods)**

Basic electrical sources: DC-Battery, AC sources–Single loop generator; Single phase and three phase supply; Electrical circuit elements (R, L and C), Ohm's law, Kirchhoff's laws, Representation of sinusoidal waveforms, peak and RMS values, phasor representation, reactive power, apparent power, real power, energy and power factor.

**UNIT-II: Principles of Electrical Systems-II (9 Periods)**

Significance of Power factor and power factor correction, most economical power factor. Typical layout of electrical grid; Typical layout and operation of Hydro, Thermal and Solar Power Plants; Fuse, circuit breaker (MCB, MCCB, RCCB, ELCB), relay (elementary treatment); Inverter and UPS (block diagram approach only). Earthing – importance of earthing, pipe earthing and plate earthing; Safety measures. Energy Efficiency (Star rating) standards by BEE.

**UNIT-III: Transformers and AC Machines (9 Periods)**

Construction and working of a single phase transformer, EMF Equation; Construction and working of three phase induction motor, torque equation, torque-slip characteristics, applications; construction and working of a resistor start &capacitor start and run single phase induction motor, applications; Construction and working of synchronous machine, applications.

**UNIT-IV: Semiconductor Devices (10 Periods)**

PN Junction diode, Characteristics, applications - half wave and full wave rectifier.Zener diode, characteristics, application–Regulator.BJT- operation, configurations, characteristics, applications - switch and amplifier.

**UNIT-V: Op-Amps (8 Periods)**

Operational Amplifier: Block diagram of Op-Amp, equivalent circuit, Op-Amp AC and DC Characteristics, Inverting and Non-Inverting modes. Applications - Adder, Comparator, Integrator and Differentiator.

**Total Periods: 45**

***Topics for Self Study are provided in the Lesson Plan***

**TEXT BOOKS**:


1. AshfaqHussain*, Fundamentals of Electrical Engineering,* Dhanpatrai& Co. (P) Ltd., *3*rd edition, New Delhi, 2009.
2. R. L. Boylestad and Louis Nashelsky, *Electronics Devices and Circuits*, PHI, 11th edition, 2009.


**REFERENCE BOOKS**:


1. M.S. Naidu, S. Kamakshaiah, *Introduction to Electrical Engineering ,*Tata McGraw-Hill Education, New Delhi, 2007.
2. D. Roy Chowdhury, *Linear Integrated Circuits*, New Age International Pvt. Ltd., 4th edition, 2011.

## I B. Tech. – I Semester

## (19BT10231) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

(Common to EEE, ECE, EIE, CSE(AI), CSE(DS) and CSBS))

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 50 | 50 | 100 | - | - | 2 | 1 |

**PRE-REQUISITES:** Physics at intermediate level.

**COURSE DESCRIPTION:** Practical investigations on Electrical circuits, AC Machines, Semiconductor Devices and Op-Amps.

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1. Analyze, measure, interpret and validate the practical observations by applying the fundamental knowledge of electrical circuits, machines and electronic devices.

CO2. Design Op-amp based amplifier, voltage summer and integrator circuits for desired specifications.

CO3. Work independently and in teams to solve problems with effective communication.

**List of Experiments:**

Minimum **Ten** experiments are to be conducted.

1. Measurement of electrical quantities (AC & DC) using Voltmeter, Ammeter and Wattmeter.
2. Verification of Ohm's law and Kirchhoff's laws.
3. Circuit
   (a) with one lamp controlled by one switch and provision of 2-pin or 3-pin socket PVC surface conduit system.
   (b) With two lamps controlled by two switches with PVC surface conduit system.
   (c) for Stair case wiring and Godown wiring.
4. Measurement of Power factor and it's improvement.
5. Load test on 1-Phase Transformer.
6. Brake test on 3-Phase Induction Motor.
7. Brake test on 1- phase induction motor.
8. VI Characteristics of PN and Zener Diodes.
9. Ripple factor and load regulations of rectifier with and without filters.
10. Input and output characteristics of CE configuration.
11. Design of inverting and non-inverting amplifiers using op-amp.
12. Design of voltage summer and integrator using op-amp.
13. Soldering practice.

**REFERENCES BOOKS/ LAB MANUALS:**


1. P. S. Dhogal, *Basic Practicals in Electrical Engineering*, Standard Publishers, 2004.
2. YannisTsividis, *A First Lab in Circuits and Electronics*, Wiley, 1st edition., 2001


**ADDITIONAL LEARNING RESOURCES:**

1. www.vlab.co.in, Virtual Electric Circuits Lab, A initiative of MHRD under NMEICT.
2. www.vlab.co.in, Basic Electronics Lab, A initiative of MHRD under NMEICT.
3. https://nptel.ac.in/courses/117106108/
4. https://ocw.mit.edu/high-school/physics/exam-prep/electric-circuits/
5. https://nptel.ac.in/courses/108105017/
6. https://nptel.ac.in/courses/108108112/
7. https://nptel.ac.in/courses/117107094/

**I B. Tech. - I Semester (ECE, EEE & EIE) /**
**I B. Tech. - II Semester (CSE,CSSE,IT,CE & ME)**

## (19BT1AC01) SPOKEN ENGLISH

(Audit Course)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| - | - | - | 2 | - | - | - |

**PRE-REQUISITES: -**

**COURSE OBJECTIVES:**

- To impart the knowledge of day to day conversational expressions.
- To enhance contextual vocabulary and technical jargon for effective usage of language.
- To improve functional grammar for speaking and writing without errors.
- To acquaint with appropriate conversational and narrating techniques for effective communication.

**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

CO1. Analyze the techniques of listening, speaking, reading, writing and apply through functional English to communicate effectively with the engineering community and society.

**DETAILED SYLLABUS:**

**UNIT I - FUNCTIONAL ENGLISH: (6 periods)**

Introduction - Functional Spoken English;Just a Minute; **Listening – Speaking:** Do's and Don'ts; **Expressing:** Ability/ Admiration/ Agreement/ Anger/ Annoyance/ Appreciation/ Pleasure/ Sarcasm/ Satisfaction/ Surprise/ Approval/ Capability/ Certainty/ Condolences/ Doubt/ Fear/ Gratitude/ Possibility/ Worry; **Asking for:** Advice/ Clarification/ Direction/ Information/ Permission/ Predictions/ a recommendation

**UNIT II -VOCABULARY BUILDING: (6 periods)**

Vocabulary for day-to-day conversations; Introduction: Vegetables/ Groceries/ Fruits/ Weather; Parts of a Human body/ Dresses/ Furniture/ Relations; Birds/ Cries of Animals; Food/ Hospitality/ Houses/ Rooms/ Tools; Airport/ News Paper/ Books/ Gems; Corporate Vocabulary/ Jobs/ Occupations/ Diseases; British/ American spelling; Slang Words and Technical Jargon

**UNIT III -FUNCTIONAL GRAMMAR - I: (6 periods)**

English Grammar and the Indian Student; Introduction: Parts of Speech, Verb forms; Tenses; Voice; Speech

**UNIT IV -FUNCTIONAL GRAMMAR - II: (6 periods)**

Universal Auxiliaries; Sentence making for an effective communication; Sentence Structure -WH- Questions - How to frame Questions and give answers; Question Tags; Subject and verb agreement; Spotting Errors

**UNIT V –COMMUNICATION SKILLS: (6 periods)**

Polite, Courteous and diplomatic terms; Useful daily expressions; Courtesy, Good manners and Etiquette; Conversation Techniques; Narrating/ Reading/ Listening to stories; Telling Stories

**Total Periods: 30**

**TEXT BOOKS:**

1. L. Adinarayana and V. Prakasam, *Spoken English*, Neelkamal Publications Pvt. Ltd., New Delhi, 2008
2. Ram Bhasker Raju, *The Complete Book on Spoken English*, Goutham Buddha Publications, Hyderabad, 2002.

**REFERENCE BOOKS :**

1. Sabina Pillai, *Spoken English for my World,* Oxford University Press, New Delhi, 2016.

2.K. R. Lakshminarayanan, *Speak in English,*Scitech Publications, Chennai, 2009.

**ADDITIONAL LEARNING RESOURCES**

- https://www.britishcouncil.in/programmes/english-partnerships/state/skills-projects/AP-English-Skills.
- https://www.fluentu.com/blog/english/websites-to-learn-english/

**I- B. Tech - I/II Semester**

**(19BT1BS02) BIOLOGY FOR ENGINEERS**

(Common to All Branches)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 2 | - | - | 2 |

**PRE REQUISITE**: --

**COURSE OBJECTIVES:**

- Tointroduce the molecular basis of life and provide the basis for classification of living organisms
- To describe about biomolecules, enzymes, genes and the transfer of genetic information**.**
- To introducethetechniquesused for modification of living organisms and applications of biology**.**

**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

CO1. Apply the basic knowledge of biology to understand the significance of various biological techniques.

CO2. Identify the role of DNA in the molecular basis of information transfer and understand single gene disorders related to the health perspective.

CO3. Apply the basic knowledge of bio-analytical devices and methods to address societal, health and legal issues.

**DETAILED SYLLABUS:**

**UNIT I – LIVING ORGANISMS (6 Periods)**

Comparison of biological organisms with manmade systems, Classification of living organisms, Cellular basis of life, differences between prokaryotes and eukaryotes, classification on the basis of carbon and energy sources, molecular taxonomy

**UNIT II – PROTEINS, NUCLEIC ACIDS AND ENZYMES (6 Periods)**

Biomolecules, structure and functions of proteins and nucleic acids, Industrial applications of enzymes, Fermentation and its industrial applications

**UNIT III – GENETICS AND MOLECULAR BIOLOGY (6 Periods)**

Mendel's laws, single gene disorders in humans, Genetic code, DNA replication, Transcription, Translation.

**UNIT IV – RECOMBINANT DNA TECHNOLOGY (6 Periods)**

Recombinant DNA Technology: recombinant vaccines, transgenic microbes, plants and animals, animal cloning, biosensors, biochips

**UNIT V –HUMAN PHYSIOLOGY AND APPLIED BIOLOGY (6 Periods)**

Fundamentals of Human physiology, neurons, synaptic and neuromuscular junctions, Introduction to EEG, DNA fingerprinting, DNA Micro array and Genomics.

**Total Periods: 30**

**TEXT BOOKS**:


1. N. A. Campbell, J. B. Reece, et al., *Biology: A global approach*, Pearson Education Ltd, 2018.
2. S. Sing and T. Allen, *Biology for Engineers*, Vayu Education of India, 2014.


**REFERENCE BOOKS**:


1. B. Alberts, A. Johnson et al., *The molecular biology of the cell*, Garland Science, 6th edition, 2014.

2. A. T. Johnson, *Biology for Engineers*, CRC press, 2011.

**I B. Tech – I Semester (CSE, CSSE, IT, CE & ME)**
**I B. Tech – II Semester (ECE, EEE & EIE)**
**(19BT1HS01) COMMUNICATIVE ENGLISH**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | 0 | -- | 3 |

**PRE-REQUISITES: -**

**COURSE OBJECTIVES:**

1. To acquaint with the nuances of effective communication correlating with academic content.
2. To understand and interpret the importance of listening techniques for effective communication.
3. To develop reading and writing techniques for effective technical communication.
4. To make use of speaking techniques to communicate effectively in formal and informal situations.

**COURSE OUTCOMES**: After successful completion of this course, students will be able to:

CO1. Analyze the modes and techniques of listening, speaking, reading, writing and apply appropriately to communicate effectively with the engineering community and society.

**DETAILED SYLLABUS:**

**UNIT I** - **INTRODUCTION TO COMMUNICATION** **(9 periods)**

Introduction – Language as a Tool of Communication – Communicative Skills (Listening, Speaking, Reading and Writing) – Effective Communication – Modes of Communication – Barriers to Communication (classification) - Case study

**UNIT II** - **ACTIVE LISTENING** **(9 periods)**

Introduction –Traits of a Good Listener – Listening Modes – Types of Listening – Barriers to Effective Listening – Listening for General Content and Specific Information - Case study

**UNIT III** - **EFFECTIVE SPEAKING** **(9 periods)**

Introduction – Achieving Confidence, Clarity and Fluency – Paralinguistic Features – Barriers to Speaking – Types of Speaking – Conferences; significance, planning and preparation and procedure – Symposia and Seminars - Persuasive Speaking - Case study

**NIT IV - READING** **(9 periods)**

Introduction – Reading and Interpretation – Intensive and Extensive Reading – Critical Reading ––Techniques for Good Comprehension- SQ3R Reading Technique –Study Skills - Case study

**UNIT V – TECHNICAL WRITING** **(9 periods)**

Introduction – Language – Elements of Style – Techniques for Good Technical Writing – Paragraphs Construction – Essays: types, Steps to Essay Writing and Checklist – Précis Writing - Case study

**Total Periods: 45**

**TEXT BOOKS**:


**1.** Meenakshi Raman & Sangeetha Sharma, *Technical Communication*, Oxford University Press, New Delhi, 2012.

**2.** Ashraf Rizvi, *Effective Technical Communication*, McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 2018.


**REFERENCE BOOKS**:


**1.** Sanjay Kumar &Pushp Lata, *Communication Skills*, Oxford University Press, New Delhi, 2013.

**2.** Rajendra Pal and J. S. Korlahalli, *Essentials of Business Communication*, Sultan Chand and Son, New Delhi, 2010.


**ADDITIONAL LEARNING RESOURCES**

1. https://www.skillsyouneed.com/ips/active-listening.html: A useful summary of what active listening skills are.
2. https://en.wikipedia.org/wiki/Active_listening: Wikipedia entry about active listening.
3. https://www.forbes.com/sites/womensmedia/2012/11/09/10-steps-to-effective-listening/#4b27a2503891: Ten steps to Active Listening (by Forbes magazine).
4. https://goo.gl/t1Uqrt: 20 tips for organizing a conference.
5. https://goo.gl/kPMr9u: 10 important issues for speakers at a conference.
6. https://goo/gl/C5bDvv: Wikihow guide to organizing a conference.

**I B. Tech. – I Semester (CSE, CSSE, IT, CE & ME)**

**I B. Tech. – II Semester(ECE, EEE & EIE)**

**(16BT1HS01) TECHNICAL ENGLISH**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | -- | 3 |

**PRE-REQUISITES:** English at Intermediate level

**COURSE DESCRIPTION:** Introduction to Communication; Active Listening; Effective Speaking; Reading; and Writing.

**COURSE OBJECTIVES:**

**CEO1.** To impart knowledge of the nuances of communication.

**CEO2.** To develop Listening, Speaking, Reading and Writing skills in order to use language effectively in distinct situations.

**CEO3.** To imbibe an attitude of assimilating language skills in the sequence of locating, retrieving, reporting, evaluating, integrating, and accurately citing in the required context.

**COURSE OUTCOMES:** On successful completion of this course, the students will be able to

**CO1:**Demonstrate knowledge in

- Process of communication
- Modes of listening
- Paralinguistic features
- Skimming and Scanning
- Elements of style in writing

**CO2:** Analyze the possibilities and limitations of language, understanding

- Barriers to Communication
- Barriers to Effective Listening
- Barriers to Speaking
- Formal and metaphorical language

**CO3:** Design and develop functional skills for professional practice**.**

**CO4:** Apply writingskills in preparing and presenting documents

**CO5:** Function effectively as an individual and as a member in diverse teams.

**CO6*:***Communicate effectively with the engineering community and society in formal and informal situations**.**

**DETAILED SYLLABUS:**

**UNIT I** - **INTRODUCTION TO COMMUNICATION: (9 periods)**

Introduction –Language as a Tool of Communication – Communicative Skills (Listening, Speaking, Reading and Writing) – Effective Communication – Modes of Communication – Barriers to Communication (classification)

**UNIT II** - **ACTIVE LISTENING:** **(9 periods)**

Introduction – Reasons for poor Listening – Traits of a Good Listener – Listening Modes – Types of Listening – Barriers to Effective Listening – Listening for General Content and Specific Information

**UNIT III** - **EFFECTIVE SPEAKING:** **(9 periods)**

Introduction – Achieving Confidence, Clarity and Fluency – Paralinguistic Features – Barriers to Speaking – Types of Speaking – Persuasive Speaking

**UNIT IV** - **READING**: **(9 periods)**

Introduction and Reading Rates – Reading and Interpretation – Intensive and Extensive Reading – Critical Reading – Reading for Different Purposes – SQ3R Reading Technique – Study Skills

**UNIT V** – **WRITING**: **(9 periods)**

Introduction – Language – Elements of Style – Techniques for Good Technical Writing – Referencing and Styling – Right Words and Phrases – Sentences

**Total Periods: *45***

**TEXT BOOKS**:

1. Meenakshi Raman & Sangeetha Sharma, *Technical Communication*, Oxford University Press, New Delhi, 2012.

**REFERENCE BOOKS**:

1. Ashraf Rizvi*, Effective Technical Communication*, McGraw-Hill Education (India) Pvt.Ltd., New Delhi, 2015.
2. Sanjay Kumar &Pushp Lata, *Communication Skills*, Oxford University Press, New Delhi, 2013.
3. Teri Kwal Gamble and Michael Gamble, *Communication Works*, Tata Mc Graw-Hill, New Delhi, 2010.
4. Rajendra Pal and J.S. Korlahalli, *Essentials of Business Communication*, Sultan Chand and Son, New Delhi, 2010.

**I B. Tech. - I/II Semester**

**(**19BT1BS04**) ENGINEERING CHEMISTRY**
(Common to All Branches)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE REQUISITE**: -

**COURSE OBJECTIVES:**

1 To provide basic knowledge in quantum-mechanical model of atom, bonding theories, water treatment, electrochemistry, corrosion, instrumental methods, fuels and lubricants.

2 To develop skills in identification of molecular shapes, measurement of hardness of water, calculation of cell potential, calorific value of fuels.

3 To impart basic knowledge pertains to various instrumental methods, their applications and characterization of molecular structures using instrumental methods.

**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

CO1. Apply the basic knowledge of quantum mechanical approach to atomic structure and bonding theories to identify shapes of different orbitals and molecules.

CO2. Analyze and solve problems associated with hardness of water, boiler troubles and address the societal, health and safety issues related to quality of water.

CO3. Apply the basic knowledge of corrosion phenomenon to identify solutions for control of corrosion and demonstrate competency in the basic concepts of electrochemical cells.

CO4. Demonstrate the basic knowledge of instrumental methods and their applications in the structural analysis of materials.

CO5. Apply the basic knowledge of fuel chemistry and lubricants to identify the quality of fuels and lubricants.

**DETAILED SYLLABUS:**

**Unit I: Atomic Structure and Bonding Theories (9 periods)**

Quantum-mechanical model of atom, Schrodinger wave equation, significance of Ψ and $\Psi^2$ , applications to particle in a box and hydrogen atom; Molecular orbital theory – bonding in homo and hetero nuclear diatomic molecules – energy level diagrams of $N_2$, $O_2$, NO and CO; Π-molecular orbitals of butadiene and benzene; VSEPR theory and molecular shapes.

**Unit II: Water Treatment (9 periods)**

Introduction, types of water, Impurities in water and their consequences. Hardness of water, units of hardness, disadvantages of hardness, measurement of hardness by EDTA

method, numerical problems on measurement of hardness of water, boiler troubles-priming & foaming, scales & sludge, caustic embrittlement, boiler corrosion, softening of water– Ion exchange process, zeolite process, desalination of brackish water by reverse osmosis, Drinking water treatment- Ozonisation & chlorination, specifications of potable water as per WHO and BIS standards. Fluoride in ground water: Effects on human health, defluoridation method – Nalgonda method; merits and demerits of various defluoridation methods.

**Unit III: Electrochemistry and Applications (10 periods)**

Electrode potential, Nernst equation, reference electrodes (Calomel electrode and glass electrode), electrochemical cell, cell potential calculations. Primary cells – dry cell, alkali metal sulphide batteries, Secondary cells – lead acid, lithium ion batteries, Fuel cells - Hydrogen-oxygen fuel cell, Methanol-oxygen fuel cell, Solid-oxide fuel cell.

**Corrosion:** Introduction, Definition, types of corrosion- wet (galvanic corrosion, concentration cell corrosion) and dry corrosion, Factors influencing corrosion, control of corrosion- sacrificial anodic protection, Impressed current cathodic protection, electroplating method (Nickel).

**Unit IV: Instrumental Methods and Applications (9 periods)**

Introduction to spectroscopy–types of energy present in molecules, types of spectra, UV-Vis spectroscopy – principle, types of electronic transitions, chromophore, auxochrome, Bathochromic shift, Hypsochromic shift, Instrumentation of UV-Vis spectrophotometer, applications; Infrared spectroscopy – principle, types of vibrational modes, group frequencies, Instrumentation of IR spectrophotometer, applications. principle and applications of physicochemical methods (SEM, TEM, X-ray diffraction).

**Unit V: Fuel chemistry and Lubricants (8 Periods)**

**Fuel chemistry**: Types of fuels, calorific value, numerical problems based on calorific value; Liquid fuels, cracking of oils (Thermal and Fixed-bed catalytic cracking), knocking and anti-knock agents, Octane and Cetane values, Synthetic petrol: Fischer-Tropsch method and Bergius process.

**Lubricants**:Definition, functions of lubricants, mechanism of lubrication, classification of lubricants, properties of lubricants – viscosity and viscosity index , flash and fire points, cloud and pour points, Aniline points, neutralization number and mechanical strength.

**Total Periods: 45**

**TEXT BOOKS:**


1. P. C. Jain & Monika Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 16th edition, 2013.
2. K.N. Jayaveera, G.V. Subba Reddy and C. Ramachandriah, *Engineering Chemistry,*Mc.Graw Hill Publishers, New Delhi.


**REFERENCE BOOKS:**


1. J. D. Lee, *Concise Inorganic Chemistry*, Oxford University Press, 5th edition 2010.
2. Skoog and West, *Principles of Instrumental Analysis*, Thomson, 6th edition, 2007.
3. Peter Atkins, Julio de Paula and James Keelar, *Atkins' Physical Chemistry*, Oxford University Press, 10th edition, 2010.

**I-B. Tech - I/II Semester**
**(16BT1BS01): ENGINEERING CHEMISTRY**
(Common to All Branches of Engineering)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | - | 3 |

**PRE REQUISITE**: Intermediate/Senior Secondary Chemistry

**COURSE DESCRIPTION**: Water technology, Chemistry of Engineering materials, Nano Chemistry, Green Chemistry, Electro chemical cells, Sensors, Corrosion and Lubricants.

**COURSE OBJECTIVES:**

1. To impart basic and applied knowledge in water technology, Chemistry of Engineering materials, Nano Chemistry, Green Chemistry, bio-diesel, electro chemical cells, sensors, corrosion and lubricants.

2. To develop skills in analysis of materials and design of systems for engineering applications.

3. To imbibe an attitude among students to practice Engineering in compliance with principles of Green Chemistry.

**COURSE OUTCOMES:** After completion of the course, a successful student is able to:

1. Acquire basic knowledge in water technology, engineering plastics, conducting polymers, composites, Electro chemical cells, Nano Chemistry, principles of Green Chemistry, corrosion phenomenon and lubricants.
2. Develop analytical skills in:
   a. Determination of hardness of water.
   b. Determination of viscosity, flame and fire points, cloud and pour points.
3. Develop designing skills in:
   a. Synthesis of engineering plastics.
   b. Chemical methods for the synthesis of Nano materials.
4. Develop skills for providing solutions through:
   a. Mitigation of hardness of water.
   b. Newer Nanomaterials and engineering plastics for specific applications
5. Acquire awareness to practice engineering in compliance to modern techniques such as:
   a. Nalgonda technique for defluoridation of water
   b. Electroplating technique for control of corrosion.
6. Acquire awareness to societal issues on:
   a. Quality of water.
   b. Bio-diesel
   c. Chemical materials utility and their impact.

**DETAILED SYLLABUS:**

**UNIT–I: WATER TECHNOLOGY [9 periods]**

Introduction, types of water, impurities in water and their consequences, types of hardness of water, units of hardness of water, disadvantages of hardness of water, estimation of hardness of water by EDTA method, Boiler troubles: Scales and Sludges,

Caustic embrittlement, Boiler corrosion and Priming and Foaming. Softening of water: Zeolite process and Ion exchange process, advantages and disadvantages. Desalination of brackish water by Reverse Osmosis, Numerical problems on estimation of hardness of water.

Fluorides in water: effects on human health, defluoridation method-Nalgonda method;comparison of merits and demerits of various defluoridation methods (Nalgonda, Bone Charcoal, Activated Alumina, Contact precipitation, Brick, Reverse osmosis).

**UNIT – II: CHEMISTRY OF ENGINEERING MATERIALS [9 periods]**

**Engineering Plastics:** Definition, general properties, synthesis, properties and applications of PC, PTFE, and PMMA.

**Conducting polymers**: Definition, types of conducting polymers: Intrinsic and extrinsic conducting polymers with examples, engineering applications of conducting polymers.

**Biodegradable polymers**: Definition, properties, classification, mechanism of degradation of biodegradable polymers and their applications.

**Composites** – Introduction, types of composites: fiber reinforced particulate and layered composites with examples, advantages of composites and applications.

**UNIT– III: NANO CHEMISTRY AND GREEN CHEMISTRY [9 periods]**

**Nano Chemistry:** Introduction, classification, properties and applications of Nano materials (nano particles, nano tubes, nano wires, nano composites, dendrimers);synthesis of Nano materials – Sol-gel process.

**Green Chemistry:** Introduction, principles of green chemistry, Tools of Green Chemistry with Examples, Applications of Green Chemistry in science and technology.

**Biodiesel:** Introduction, Synthesis (Trans esterification method), advantages, disadvantages and applications.

**UNIT–IV: ELECTROCHEMICAL CELLS AND SENSORS [9 periods]**

**Electrochemical cell**: Introduction, EMF of an electrochemical cell.

**Batteries:** Introduction, types of Batteries: primary and secondary batteries with examples, Ni-Cd batteries, Lithium-ion batteries, Lithium- Polymer batteries, Applications of batteries.

**Fuel Cells:** Definition, examples: $H_2 – O_2$ Fuel cell, solid oxide fuel cell, Bio-fuel cell and applications of fuel cells.

**Sensors** - Introduction, Types of Sensors, electrochemical sensor: construction and working principle of potentiometric sensor, and applications of electrochemical sensors.

**UNIT–V: CORROSION AND LUBRICANTS [9 periods]**

**Corrosion:** Introduction, Definition, types of corrosion (dry and wet corrosion), galvanic corrosion, concentration cell corrosion, Factors influencing corrosion, Corrosion control: cathodic protection; sacrificial anodic protection and impressed current cathodic protection; protective coatings: Galvanizing and Electroplating (Nickel).

**Lubricants:** Definition, functions of lubricants, mechanism of lubrication, classification of lubricants, properties of lubricants – viscosity, flash and fire points, cloud and pour points, Aniline points, neutralization number and mechanical strength.

**Total periods: 45**

**TEXT BOOKS:**


1. P.C.Jain& Monika Jain, **Engineering Chemistry**, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 16th edition, 2013.
2. K.N. Jayaveera, G.V. Subba Reddy & C. Ramachandraiah**Engineering Chemistry**,
   Mc. Graw-Hill Higher Education, Hyderabad, 1st edition, 2015.


**REFERENCE BOOKS:**


1. A.K. Bandyopadhyay, **Nano Materials,**New Age international publishers, 2nd edition, 2014.
2. Paul T. Anastas, John C Warner, **Green Chemistry: Theory and practice,**Oxford University Press, 2000

**I B.Tech. - I/II Semester**
**(**19BT1BS32**) ENGINEERING CHEMISTRY LABORATORY**
(Common to All Branches of Engineering)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 50 | 50 | 100 | - | - | 2 | 1 |

**PRE REQUISITE:** -

**COURSE OBJECTIVES:**

- To impart knowledge in basic principles of volumetric and instrumental methods of analysis.
- To develop practical skills encompassing quantitative analysis of materials by volumetric methods.
- To develop practical skills to analyze the materials by instrumental methods.

**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

CO1. Apply analytical skills for the quantitative estimation of materials through volumetric methods of analysis and address the societal, health issues related to quality of water.
CO2. Develop analytical skills for the quantitative estimation of materials through instrumental methods of analysis.
CO3. Work independently and in teams to solve problems with effective communication.

A minimum of any **Ten** experiments are to be conducted among the following:

**LIST OF EXPERIMENTS :**

1. Estimation of Hardness of water by EDTA method
2. Determination of alkalinity of Water sample
3. Estimation of Dissolved Oxygen in water by Winkler's method.
4. Estimation Fe (II) by Dichrometry
5. Conductometric titration of strong acid Vs strong base
6. Estimation of Ferrous ion by Potentiometry
7. Determination of strength of acid by $P^H$ metric method
8. Determination of Strength of an acid in Pb-Acid battery
9. Determination of Viscosity by Ostwald's viscometer
10. Determination of percentage of Iron in Cement sample by colorimetry
11. Estimation of residual chlorine in drinking water.
12. Identification of simple organic compounds by UV-Vis and IR spectroscopy

**TEXT BOOKS:**


1. K. Mukkanti, *Practical Engineering Chemistry*, BS Publications, 2013.
2. K.N. Jayaveera, K.B. Chandra Sekhar, *Chemistry laboratory manual*, S.M. Enterprises Limited, 2013.

**I-B. Tech- I/II Semester**

**(16BT1BS31): ENGINEERING CHEMISTRY LABORATORY**

(Common to All Branches of Engineering)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | - | - | 3 | 2 |

**PRE REQUISITE:** Intermediate/Senior Secondary Chemistry

**COURSE DESCRIPTION:** Estimation of hardness, alkalinity, dissolved oxygen of water samples and estimation of Iron by volumetric methods, determination of effect of $P^H$ on rate of corrosion, measurement of viscosity of lubricants; Instrumental methods like potentiometer, conductivity meter, $P^H$ meter and colorimeter; synthesis of Polymers and Nano materials.

**COURSE OBJECTIVES:**

This course enables the students to:

1. Develop practical skills encompassing quantitative analysis of materials by volumetric methods, instrumental methods and acquire designing skills for the synthesis of Nano materials and Engineering plastics.

**COURSE OUTCOMES:**

After completion of the course, a successful student is able to:

1. Acquire basic knowledge about the volumetric analysis and synthesis of materials used for engineering applications**.**
2. Acquire analytical skills in the estimation of hardness of water, alkalinity of water, dissolved oxygen in water and estimation of Iron through wet laboratory methods.
3. Develop designing skills for the synthesis of polymers and Nanomaterials.
4. Acquire skills to use instrumental techniques for the determination of Electrical conductance of electrolytes, EMF of a cell, $P^H$ of a solution, determination of viscosity of lubricants and estimation of iron in cement.
5. Provide solutions for environmental issues through determination of quality of water.

A minimum of any **Ten** experiments are to be conducted among the following:

**LIST OF EXPERIMENTS:**

1. Estimation of Hardness of water by EDTA method.
2. Estimation of alkalinity of Water.
3. Estimation of Dissolved Oxygen in water.
4. Estimation of Ferrous Iron by Dichrometry.

5. Preparation of Novalac Resin.
6. Synthesis of Nano metal-oxide using sol– gel process.
7. Conductometric titration of strong acid Vs strong base
8. Estimation of Ferrous ion by Potentiometry.
9. Determination of amount of corrosion of metals in different medium
10. Measurement of viscosity of lubricants by Ostwald viscometer.
11. Determination of $P^H$ of a given solution by $P^H$ metry.
12. Estimation of Ferric iron in cement by Colorimetric method.

**Duration: 3 Periods for each experiment**

**Total periods: 36**

**TEXT BOOKS:**


1. K. Mukkanti, *Practical Engineering Chemistry*, BS Publications, 2013.
2. K.N. Jayaveera, K.B. Chandra Sekhar, *Chemistry laboratory manual*, S.M. Enterprises Limited, 2013.

**I B. Tech. – II Semester**

**(19BT2BS02) APPLIED PHYSICS**

(Common to Civil and Mechanical Engineering)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | 0 | -- | 3 |

**PREREQUISITES**: --

**COURSE OBJECTIVES:**

- To impart fundamental knowledge in the area of mechanics, acoustics, ultrasonics, dynamic motion of a particle, heat energy and modern materials.
- To familiarize the application of modern materials and sensors to civil and mechanical engineering.

**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

CO1. Apply the basic knowledge of fiber optics, acoustics and ultrasonics to provide solutions for various engineering problems.

CO2. Analyze and solve the problems associated with kinetics, kinematics and thermal physics.

CO3. Demonstrate the knowledge on characteristics and applications of modern engineering materials.

**DETAILED SYLLABUS:**

**Unit-I: FIBER OPTICS (8 periods)**

Introduction, structure of an optical fiber, total internal reflection, acceptance angle, acceptance cone and numerical aperture, modes of propagation, classification of optical fibers, V-number (qualitative), fabrication of optical fiber by double crucible technique, applications of optical fibers, sensors (temperature, displacement, liquid level detector).

**UNIT-II: ACOUSTICS AND ULTRASONICS (9 periods)**

**Acoustics** - Introduction, classification of sound, sound intensity level (decibel), reverberation, reverberation time, absorption coefficient and its determination, Sabine's formula (qualitative), factors affecting acoustics and their remedies, basic requirements of an acoustically good hall.

**Ultrasonics** - Introduction to ultrasonic waves, production of ultrasonic waves by piezoelectric method, magnetostriction method, detection of ultrasonics (qualitative), industrial applications (ultrasonic welding, ultrasonic soldering and ultrasonic drilling).

**UNIT-III: KINEMATICS AND KINETICS (10 periods)**

**Kinematics of particles** - Rectilinear motion (displacement-time curve, velocity-time curve, acceleration-time curve), curvilinear motion (velocity and angle of projection, equation of trajectory path, horizontal range) - inclined projection (equation of trajectory, maximum height, time of flight of projectile, horizontal range, angle of projection).

**Kinetics** - Bodies in rectilinear translation, kinetics of bodies rotating about fixed axis, work, energy, power, work-energy equation for translation.

**UNIT-IV: THERMAL PHYSICS (8 periods)**

Introduction, modes of heat transfer (conduction, convection and radiation), coefficient of thermal conductivity, rectilinear flow of heat along a uniform bar, thermal conductivity of bad conductor (Lee's disc method), heat conduction through compound media (materials in series and parallel).

**UNIT V:MODERN ENGINEERING MATERIALS (10 periods)**

**Metallic glasses** - Introduction, preparation of metallic glasses by RF sputtering technique, properties (structural, thermodynamic, mechanical, electrical, chemical and optical), applications of metallic glasses.

**Shape memory alloys (SMA)** – Introduction, shape memory effect and its types, characteristics of SMA, properties of NiTi alloy, applications of SMA.

**Composites** - Introduction, types and applications.

**Total periods: 45**

**TEXT BOOKS:**


1. M. N. Avadhanulu, P. G. Kshirsagar, T. V. S. Arun Murthy, *A Textbook of Engineering Physics* - S. Chand Publications, 11th edition, 2019.
2. S. S. Bhavikatti and K. G. Rajashekarappa, *Engineering Mechanics*, New Age International Publishers, 2nd edition, 2015.


**REFERENCE BOOKS:**


1. B. K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Learning, 2012.
2. Brij Lal and N. Subrahmanyam, *Heat and Thermodynamics,* S. Chand and Company Ltd., 1995.

**I B. Tech. – II Semester**

(19BT2BS31) **APPLIED PHYSICS LAB**

(Common to Civil and Mechanical Engineering)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 50 | 50 | 100 | - | - | 2 | 1 |

**PRE REQUISITE:** --

**Course Objectives:**

- To gain practical knowledge in all experiments by correlating with the theoretical concepts in Physics.
- To analyze and interpret experimental data along with graphical analysis.
- To discuss the basic principles of scientific concepts in various engineering branches.

**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

**CO1**. Demonstrate the experimental procedures to compute the frequency of a tuning fork, hall coefficient, energy gap, moment of inertia, rigidity modulus and thermal conductivity of materials.

**CO2**. Apply skills to plot various characteristic curves of an optical Fiber and also determine thermal conductivity, thermo emf and energy gap.

**CO3**. Work independently and in teams to solve problems with effective communication.

A minimum of **Ten** experiments are to be conducted among the following:

**LIST OF APPLIED PHYSICS EXPERIMENTS:**

1. Determination of moment of inertia of a bar and acceleration due to gravity - Compound Pendulum.
2. Moment of inertia of a Flywheel.
3. Bifilar Pendulum - Moment of inertia of a rectangular body.
4. Melde's Experiment – Determine the frequency of electrically driven tuning fork.
5. Determination of thermal conductivity of a good conductor (Forbe's Apparatus).
6. Determination of thermal conductivity of a bad conductor (Lee's disc method).
7. Thermal Expansion of Solids - Bimetallic Strip.
8. Study of characteristics of an optical sensor.
9. Verification of Newton's Law of Cooling for any two liquids.

10. Determination of number of charge carriers per unit volume and hall coefficients of a given material using Hall Effect.
11. Rigidity Modulus of a material of a wire - Torsional Pendulum

12. Thermocouple - Seebeck Effect.

13. Determine the energy gap of a material by varying temperatures.

**REFERENCES:**


1. Balasubramanian S, Srinivasan M.N and Ranganathan, *A Text book of Practical Physics,* R, Sultan Chand & Sons, 2017.

2. https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=354&cnt=1

**I B. Tech. - II semester**

(19BT2BS01) **TRANSFORMATION TECHNIQUES AND LINEAR ALGEBRA**

**(Common to All Branches**)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | 1 | -- | 4 |

**PRE-REQUISITE:** -

**COURSE OBJECTIVES:**

- To familiarize with Fourier series of a periodic function, the Fourier integral of a function and the Fourier transformation.
- To introduce Laplace transform techniques for solving differential equations.
- To acquaint the students with concepts of matrices and linear transformations useful in engineering contexts.

**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

CO1: Apply the knowledge of Fourier and Laplace transform techniques to solve differential equations.

CO2: Analyze linear transformations and associated matrices to solve engineering problems by applying the knowledge of linear algebra.

**DETAILED SYLLABUS:**

**UNIT- I: Fourier Series and Fourier Transforms (9 Periods)**

Fourier series:Determination of Fourier coefficients, Euler's formulae, convergence of Fourier series (Dirichlet's conditions), Fourier series in $(0,2l),(-l,l)$; Fourier series of even and odd functions; Half-range Fourier sine and cosine expansions in $(0,l)$; Fourier integral theorem (statement only), Fourier sine and cosine integrals; Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier transforms.

**UNIT-II: Laplace Transforms (9 Periods)**

Definition of Laplace transform, existence conditions, Laplace transform of standard functions, Properties of Laplace transforms, Laplace Transforms of derivatives, Laplace Transforms of integrals, multiplication by $t^n$, division by t, Laplace transform of periodic functions, Laplace transforms of unit step function and unit impulse function.

**UNIT- III: Inverse Laplace Transforms (9 Periods)**

Inverse Laplace transform by different methods; Convolution theorem (without proof), inverse Laplace transforms by convolution theorem; Applications of Laplace transforms to ordinary differential equations of first and second order with constant coefficients.

**UNIT- IV: Linear Algebra-I (Matrices) (9 Periods)**

Rank of a matrix: echelon form; Linear systems of equations: solving system of Homogeneous and Non-Homogeneous equations; Eigen values and Eigen vectors of a matrix and properties (without proofs), Diagonalization of matrix by orthogonal transformation; Quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical form by orthogonal transformation.

**UNIT- V: Linear Algebra-II (Vector Spaces) (9 Periods)**

Vector spaces, Linear dependence and independence of vectors, basis, dimension, Linear transformations (maps), range and kernel of a linear map, rank and nullity, inverse of a linear transformation, rank-nullity theorem (without proof), matrix associated with a linear map.

**Total Periods: 45**

**TEXT BOOKS:**


1. T.K.V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M.V.S.S.N. Prasad, *Engineering Mathematics-II*, S. Chand & Company, 10th edition, 2016.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44th edition, 2017.
3. David Poole, *Linear Algebra: A Modern Introduction*, Brooks/Cole, 2nd edition, 2005.


**REFERENCE BOOKS**:


1. B.V. Ramana, *Higher Engineering Mathematics*, Tata McGraw hill, 1st edition, 2017.
2. V.Krishna Murthy, Mainra and Arora: *An Introduction to Linear Algebra*, Affiliated East-West Press, 1993.

**I B. Tech. – II Semester**

**(16BT2BS01) TRANSFORMATION TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS**

**(Common to all Branches of Engineering)**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | -- | 3 |

**PRE REQUISITE**: Intermediate /Senior secondary mathematics

**COURSE DESCRIPTION**: Fourier series; Fourier integrals and transforms; Laplace transforms; z –transforms; partial differential equations.

**COURSE OBJECTIVES:**

CEO 1 :To impart basic knowledge on Fourier series, Fourier transforms, Laplace transforms, z-transforms and partial differential equations.

CEO 2 :To develop skills in analyzing the problems ,designing mathematical models, Fourier series, Fourier transforms, Laplace transforms, z-transforms and partial differential equations for the problems in engineering.

**COURSE OUTCOMES:** After completion of the course a successful student is able to

CO 1 :Acquire basic knowledge in
- (a) Fourier series and Fourier transforms
- (b) Fourier integrals
- (c) Laplace transforms and their applications
- (d) z- transforms and their applications
- (e) solving partial differential equations
- (f) Heat transfer and wave motion

CO 2 : Develop skills in analyzing the
- (a) Properties of Fourier series for a given function
- (b) Partial differential equations through different evaluation methods
- (c) Difference equations through z – transforms
- (d) Engineering systems and processes involving wave forms and heat transfer

CO 3 :Develop skills in designing mathematical models for
- (a) Problems involving heat transfer and wave forms
- (b) Engineering concepts involving, Fourier transforms, Fourier integrals, Laplace transforms, z-transforms and difference equations

CO 4 :Develop analytical skills in solving the problems involving
- (a) Fourier series and Fourier transforms
- (b) Laplace transforms
- (c) Z-transforms and difference equations
- (d) Heat transfer and wave motion

CO 5 : Use relevant transformation techniques for
- (a) Obtaining Fourier transforms for different types of functions

(b) Laplace transforms
(c) Z- transforms
(d) Partial differential equations

**DETAILED SYLLABUS**

**UNIT- I : FOURIER SERIES (7 periods)**

**Fourier series:**Determination of Fourier coefficients,convergence of Fourier series (Dirichlet'sconditions),Fourier series of even and odd functions, Half-range Fourier sine and cosine expansions.

**UNIT- II: FOURIER INTEGRALSAND FOURIER TRANSFORMS (8 periods)**

Fourier integral theorem (statement only), Fourier sine and cosine integrals, Fourier transform, Fourier sine and cosine transforms –properties, Inverse transform and finite Fourier transforms.

**UNIT-III:LAPLACE TRANSFORMS (12 periods)**

Laplace transforms of standard functions. Properties of Laplace transforms. First and second shifting Theorems. Laplace transforms of derivatives and integrals. Inverse transforms. Convolution theorem (without proof), inverse Laplace transforms by convolution theorem. Laplace transform of periodic functions, Applications of Laplace transforms to ordinary differential equations of first and second order with constant coefficients.

**UNIT-IV : Z- TRANSFORMS (9 periods)**

Z – transforms, inverse Z– transforms, damping rule, shifting rule, initial and final value theorems. Convolution theorem(without proof), solution of difference equations by Z– transforms.

**UNIT – V : PARTIAL DIFFERENTIAL EQUATIONS (9 periods)**

Formation of Partial differential equations – Solutions of first order linear equations by method of grouping. First and second order equations by method of separation of variables – Solutions of one dimensional Wave equation, Heat equation.

**Total no. of periods: 45**

**TEXT BOOK:**


1. T.K.V. Iyengar, B. Krishna Gandhi,S.Ranganatham and M.V.S.S.N. Prasad,***Engineering Mathematics, vol-1***, S. Chand & Company 13/e,2014.
2. T.K.V. Iyenger, B. Krishna Gandhi, S.Ranganadham and M.V.S.S.N.Prasad, ***Mathematical Methods***,S.Chand and Company, 8/e,2013


**REFERENCE BOOKS:**


1. Grewal, B.S., ***Higher Engineering Mathematics***,Khanna publishers, Delhi, 42/e,2012

2. Kreyszig, E., ***Advanced Engineering Mathematics***,John Wiley and Sons, Inc.,9/e,2013.

**II B. Tech. – II Semester (ECE, EEE and EIE)/**

**III B. Tech. – I Semester (CSE, CSE (AI), CSE (DS), CSBS, CSSE, IT, CE and ME)**

## (19BT4BS01) MATERIAL SCIENCE

(Open Elective-1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Introduction to Material Science and Engineering; Composite Materials; Smart Materials; Nano and Biomimetic Materials; Emerging Materials.

**COURSE OBJECTIVES:**

- To impart knowledge on processing, structure and properties of materials like composite materials, smart materials, biomimetric materials and nanomaterials.
- To develop awareness among the students about the impact of material science in engineering practices.

**COURSE OUTCOMES:**

After successful completion of the course, students will be able to:

CO1. Attain the basic knowledge on composites, smart materials, biomimetic materials and nano materials.

CO2. Demonstrate essential information about structure and properties of various composites used in various engineering applications.

CO3. Understand the basic properties of electro-rheostatic, magneto-rheostatic and shape memory alloys used in device applications.

CO4. Accomplish the basic knowledge in nanomaterials to familiarize various nano structured device applications.

CO5. Outline the processing and properties of functionally graded materials and identify its applications in various fields.

**DETAILED SYLLABUS:**

### UNIT- I: INTRODUCTION TO MATERIAL SCIENCE AND ENGINEERING

**(08 Periods)**

Introduction - historical perspective - material science and engineering, classification of materials (metals, ceramics, polymers and composites) and advanced materials and their applications (biomaterials, smart materials and nanomaterials), modern materials needs. Processing, properties and applications of metals, polymers and ceramics (Qualitative).

**UNIT- II: COMPOSITE MATERIALS (10 Periods)**

Composite Materials - Classification, Laminated composites and Reinforced composite materials – Classification, structure and properties of sandwich composites – applications (commercial Aircraft, Marine Grade Sandwich, Automobile Grade Sandwich and Wind Turbine Blades), properties and applications of Nano composites - Advantages and Limitations of composites.

**UNIT- III:SMART MATERIALS (07 Periods)**

Classification of smart materials -Magneto-rheostatic (MR) and Electro-rheostatic (ER) materials - Shape Memory Alloys (SMA)- characteristics, Shape memory effect applications in different fields, advances in smart materials.

**UNIT – IV: NANO AND BIOMIMETIC MATERIALS (10Periods)**

**Nanomaterials:** Introduction, Low dimensional structures and energy quantization. Fabrication of nano materials - Lithographic technique using photons, metallic, semiconducting and magnetic properties of nano materials and applications (renewable energy and nano electro-mechanical systems (NEMS)).

**Biomimetic materials** – Introduction- classification and their applications (Lotus effect, Dolphin sound wave technology and viper as a model in defence)

**UNIT- V: EMERGING MATERIALS (10 Periods)**

Functionally graded materials (FGM) - Types, processing, properties and potential applications, functionally graded fibre cement – structural material, Functionally Graded Nanoelectronic, Optoelectronic and Thermoelectric Materials (Qualitative) and its applications.

**Total Periods: 45**

**TEXT BOOKS:**


1. William D Callister, David G Rethwisch, *Materials Science and Engineering*, Wiley, 9th edition, 2014.
2. K M Gupta, *Engineering Materials – Research, Applications and Advances*, CRC press (Taylor & Francis group), 2015.


**REFERENCE BOOKS:**


1. Sulabha K Kulkarni, *Nanotechnology: Principles and practices*, Springer, 9th edition, 2014.
2. Charles P. Poole and Frank J. Owens, *Introduction to Nanotechnology*, Wiley-Interscience, May 2003.
3. Sulabha K Kulkarni, *Nanotechnology: Principles and Practices,* Springer, 3rd edition, 2014.

**II B. Tech. – II Semester**
**(CSE, CSE (AI), CSE (DS), CSBS, CSSE, IT, CE and ME)/**
**III B. Tech. – I Semester (ECE, EEE and EIE)**

## (19BT4HS05)GENDER AND ENVIRONMENT

(Open Elective-2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Gender and the environment relationship, Gendered Roles in the family & community, Gender and sustainable development, Gender in environmental justice, Gender &environmental security.

**COURSE OBJECTIVES:**

- To enhance understanding of environmental issues by considering the particular experiences of women and men in the face of environmental degradation and key areas in gender-environment relations and gender roles in thefamily, community and international levels.
- To trace how different feminisms, build on the core concepts of sustainability and justice to transform familiar debates in global environmental politics.
- To provide analysis of how gender relations affect the natural environment and how environmental issues have a differential impact on women and men.

**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

**CO1:**Apply the knowledge of gender & environment connections, key issues and topics within global environmental politics in environmental decision-making.

**CO2:**Comprehend the concepts of gender and sustainable development through debates, and policy documents.

**CO3:**Analyze the concept of environmental security and justice by identifying the sources of insecurity.

**DETAILED SYLLABUS**

### UNIT I: GENDER ANDENVIRONMENT RELATIONSHIP (9 Periods)

Introduction–Gender and Environment–Development of gender roles–Society, gender & environment – Understanding environmental politics – Gender-environment connections–Eco-feminism - Cultural eco-feminism–Social eco-feminism - Feminist political ecology

**UNIT II: GENDERED ROLES IN THE FAMILY & COMMUNITY (9 Periods)**

Organization of the household – Domestic division of labour - Food: growing, harvesting, shopping, preparing, and cooking
Gender & Power- Planning – Politics – NGO – Gendering of environmental protest – Environmental decision-making

**UNIT III: GENDER ANDSUSTAINABLE DEVELOPMENT (9 Periods)**

Concept of sustainability & its achievement – Concept of sustainable development – Ecological Modernization – Gender & sustainability debates – Gender & sustainable development debates - Gender in policy documents – Gender, poverty & equity in sustainable development

**UNIT IV: GENDER IN ENVIRONMENTAL JUSTICE (9 Periods)**

Normative Concerns ( Fairness, Inequality & Justice) - Making sense of Environmental justice – Ecological debt, Transnational harm,& human rights – Ecological justice – Gender & Environmental Justice – Gender, Vulnerability & risk – Women in environmental justice movements – Knowledge & participation – Gender, sustainability& justice as guiding concepts

**UNITV: GENDER AND ENVIRONMENTAL SECURITY (9 Periods)**

Connections between security & the environment – **Gender, environment &security:**Sustainability as security - poverty & insecurity – Insecurity as injustice – Competing ways of thinking security – Reflecting on sources of insecurity – **Case Study** – Food Security -**Case Study** – The impacts of natural disasters

**Total Periods: 45**

**TEXT BOOKS:**

1. Nicole Detraz. (2017) "Gender and the Environment"Polity Press, Cambridge, UK.
2. Susan Buckingham- Hatfield. (2000) "Gender and Environment"Routledge, London.

**REFERENCE BOOKS:**

1. Promillakapur (ed). (2000). "Empowering Indian Women" Publication Division, Government of India, New Delhi.
2. Ronnie Vernooy, (Ed). (2006). "Social and gender Analysis Natural Resource Management: Learnning studies and lessons from Aisa" Sage, New Delhi.
3. Swarup, Hemlata and Rajput, Pam. (2000). Gender Dimensions of Environmental and Development Debate: The Indian Experience" In SturatS.Nagel, (ed). "India"s Development and Public Policy".Ashgate, Burlington.

**II B. Tech. – II Semester**
**(CSE, CSE (AI), CSE (DS), CSBS, CSSE, IT, CE and ME)/**
**III B. Tech. – I Semester (ECE, EEE and EIE)**

## (19BT4HS09) LIFE SKILLS

(Open Elective-2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Positive attitude; Self-discovery-Interpersonal relationships; Cross-cultural communication; Core thinking-Problem solving and Decision making; Business presentations and Public speaking.

**COURSE OBJECTIVES:**

- To inculcate skills for self-efficacy required to manage effective interpersonal relationships.
- To familiarize the strategies involved in problem solving, decision making and SWOT analysis.
- To develop presentation skills required in professional arena.

**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

**CO1.** Gain knowledge in strategies involved in developing positive attitude, process ofknowing oneself and managing effective interpersonal relationships.

**CO2.** Analyse problem solving strategies in Decision Making and SWOT analysis.

**CO3.** Communicate effectively with Engineering Community and Society by demonstrating presentation skills in professional arena.

**DETAILED SYLLABUS:**

**UNIT I: POSITIVE ATTITUDE (9 Periods)**

Introduction, Features of attitudes, Formation of attitudes, Ways of changing attitude in a person, Attitude in a work place, Developing positive attitude, Obstacles in developing positive attitude, Measuring attitude.

**UNIT II: SELF DISCOVERY AND INTERPERSONAL RELATIONSHIPS (9 Periods)**

Importance of knowing yourself, Process of knowing yourself, SWOT Analysis, Elements of attitude in interpersonal relationships, Methods to deal with different types of interpersonal relationship skills.

**UNIT III: CROSS-CULTURAL COMMUNICATION (9 Periods)**

Different Communication Styles, Cultural variables, communication sensitivity and variables of national culture, Individual Cultural Variables, Cross-cultural Communication Strategies, Potential hot spots in cross-cultural communication, Cross-cultural communication – Basic Tips.

**UNIT IV: CORE THINKING, PROBLEM SOLVING AND DECISION MAKING (9 Periods)**

Process of developing core thinking skills, Categories of thinking: Critical & Creative, Understanding problem solving, Cause of problems, Stages of problem solving, Methods of problem solving, Types of decision making.

**UNIT V: BUSINESS PRESENTATIONS AND PUBLIC SPEAKING (9 Periods)**

Business presentations and speeches, structuring the material, Types of delivery, Guidelines for delivery, Effective sales presentation, Controlling nervousness and stage fright.

**Total Periods: 45**

**TEXT BOOKS:**

1. Dr. K. Alex (2018) Soft Skills, S. Chand and Company Limited, New Delhi.

2. Manmohan Joshi (2017) Soft Skills, bookboon.com, Bangalore.

**REFERENCE BOOKS:**

1. Meenakshi Raman and Prakash Singh (2013), Oxford University Press, New Delhi.

2. Jeff Butterfield (2011) Soft Skills for Everyone, Cengage Learning India Private Limited, Delhi.

**II B. Tech. – II Semester**

**(CSE, CSE (AI), CSE (DS), CSBS, CSSE, IT, CE and ME)/**

**III B. Tech. – I Semester (ECE, EEE and EIE)**

## (19BT4HS11) PROFESSIONAL ETHICS

(Open Elective -2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Engineering Ethics; Professional Ideals and Virtues; Engineering as Social Experimentation; Responsibilities and Rights; Global Issues.

**COURSE OBJECTIVES:**

- To impart fundamental concepts of engineering ethics, professional values and social responsibility.
- To develop skills in discharging the professional responsibilities as managers, advisors and leaders
- To apply code of ethics in workplace.

**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge in Engineering Ethics, Responsibilities and Rights.

CO2. Analyze the concepts of Engineering in Social Experimentation and Global Issues.

CO3**.** Apply the nuances of professional ideals at work place and in social context.

**DETAILED SYLLABUS:**

**UNIT - I: ENGINEERING ETHICS (9 periods)**

Scope and aim of engineering ethics, Senses of engineering ethics, Variety of moral issues, Types of inquiry, Moral dilemmas, Moral autonomy-Kohlberg's theory, Gilligan's theory, Consensus and controversy.

**UNIT - II:PROFESSIONAL IDEALS AND VIRTUES (8 periods)**

Theories about virtues, Professions, Professionalism, Characteristics, Expectations, Professional responsibility, Integrity, Self-respect, Sense of responsibility, Self-interest, Customs and religion, Self-interest and ethical egoism, Customs and ethical relativism, Religion and divine command ethics, Use of ethical theories, Resolving moral dilemmas and moral leadership.

**UNIT - III:ENGINEERING AS SOCIAL EXPERIMENTATION (10 periods)**

Engineering as experimentation, Similarities to standard experiments, Learning from the past and knowledge gained, Engineers as responsible experimenters, Conscientiousness, Moral autonomy and accountability, The challenger case, Codes of ethics and limitations, Industrial standards, Problems with the law of engineering.

**UNIT - IV: RESPONSIBILITIES AND RIGHTS (9 periods)**

Collegiality and loyalty, Respect for authority, Collective bargaining, Confidentiality, Conflict of interests, Occupational crime, Rights of engineers, Professional rights, Whistle-blowing, The BART case, Employee rights and discrimination.

**UNIT - V: GLOBAL ISSUES (9 periods)**

Multinational corporations, Professional ethics, Environmental ethics, Computer ethics, Engineers as consultants, Witnesses, Advisors and Leaders, Engineers as Managers, Managerial ethics applied to Engineering Profession, moral leadership.

**Total Periods: 45**

**TEXT BOOKS:**


1. Mike W. Martin and Roland Schinzinger, *Ethics in Engineering*, Tata McGraw-Hill, 3rd edition, 2007.
2. Govindarajan, M., Nata Govindarajan, M., Natarajan, S. and Senthilkumar, V. S., *Engineering Ethics*, Prentice Hall of India, 2004.


**REFERENCE BOOKS:**


1. S. Kannan and K. Srilakshmi, *Human Values and Professional Ethics*, Taxmann Allied Services Pvt Ltd., 2009.
2. Edmund G. Seebauer and Robert L. Barry, *Fundamental of Ethics for Scientists and Engineers*, Oxford University Press, 2001.

**II B.Tech.- II Semester**
**(ECE, EEE and EIE)/**
**III B.Tech.- I Semester**
**(CSE, CSE (AI), CSE (DS), CSBS, CSSE, IT, CE and ME)**

## (19BT4HS12) WOMEN EMPOWERMENT (Open Elective-1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

**COURSE DESCRIPTION:** Concept & Framework, Status of Women, Women's Right to work, International Women's Decade, and Women Entrepreneurship.

**COURSE OBJECTIVES:**

- To provide knowledge on the concept and framework for women empowerment, socio-economic political status of the women and develop consciousness among themselves to fight for their rights,
- To witness unprecedented efforts from various sectors to reassess the roles of women, to enlarge the information base, to search for alternative strategies for women's equality and development and to develop policies and programs addressed to women's specific problems and needs.
- To create awareness on women entrepreneurship and schemes for the development of women entrepreneurship and entrepreneurial challenges and opportunities

**COURSE OUTCOMES:** After successful completion of the course, the students will be able to:

**CO1:** Demonstrate the characteristics of empowered women, their achievements, and frame work for women empowerment, legal laws, and political status of women.

**CO2:** Apply the knowledge of women rights to address various societal issues and obstacles in different fields including science and technology.

**CO3:** Understand the significance of participation in policy debates, National conferences and common forums for women's' equality and development.

**CO4:** Analyze the concept of women entrepreneurship, government schemes and entrepreneurial challenges and opportunities.

**DETAILED SYLLABUS:**

**UNIT I: CONCEPT & FRAMEWORK (9 Periods)**

Introduction- Empowered Women's Characteristics- Achievements of Women's Empowerment **Concept of Empowerment:** Meaning& Concept- Generalizations about Empowerment -Empowerment Propositions - Choices women can make for empowerment - Women's participation in decision making, development process & in Governance.

**Framework for Women's Empowerment** - Five levels of equality- Tenets of Empowerment- Elements - Phases and aspects - Techniques - Categories and Models – Approaches.

**UNIT II: STATUS OF WOMEN (9 Periods)**

**Legal Status:** Present Scenario- Call for Social change- Significant trends - Legal & Schemes - Personal Law- Joint Family- Criminal Law- Shift towards Dowry - Deterrent Punishment - Criminal Law(II Amendment) - Discrimination in Employment

**Political Status:** Present Scenario - Political Participation & its Nature- Socio-economic Characteristics - Political Mobilization: Mass Media - Campaign Exposure - Group Orientation - Awareness of issues and participation - Progress & Future Thrust.

**UNIT III: WOMEN'S RIGHT TO WORK (9 Periods)**

Introduction- Present Scenario - Changes in Policy &Programme - National Plan of Action- Women's Cells and Bureau - Increase in work participation rate- Discrimination in labourmarket - Women in unorganized sector - Issues and Obstacles- Women in Education - Women in Science & Technology –

**Case Study:** Linking Education to Women's Access to resources.

**UNIT IV: WOMEN'S PARTICIPATORY DEVELOPMENT (9 Periods)**

Dynamics of social change- conscious participation - Information Explosion - Organized Articulation - National Conference - Common Forums - Participatory Development - New Issues Identified - Role of other Institutions.

**UNIT V: WOMEN ENTREPRENEURSHIP (9 Periods)**

Introduction–Definition-Concept- Traits of women Entrepreneurs- Role of women Entrepreneurs in India -Reasons of Women Entrepreneurship- Government schemes & Financial Institutions to develop Women Entrepreneurs - Key policy recommendations - Project Planning-Suggestions and measures to strengthen women entrepreneurship - Growth & Future challenges - Training and Opportunities –

**Case Study:** Training Women as Hand-pump Mechanics

**Case Study** : Literacy for Empowering Craftswomen

**Total Periods: 45**

**TEXT BOOKS:**


1. NayakSarojini, Nair Jeevan(2017), "Women's Empowerment in India". Pointer Publishers, Jaipur
2. SahaySushama (2013), "Women and Empowerment" Discovery Publishing House, New Delhi.

## II B. Tech. - II Semester

## (19BT40107) SUSTAINABLE ENGINEERING

(Open Elective-2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:** --

**COURSE DESCRIPTION:** Principles of sustainability; Sustainability metrics and assessment tools; Sustainable engineering practices; Sustainable engineering applications; Sustainable urbanization and industrialization.

**COURSE OUTCOMES:** *After successful completion of the course, students will be able to:*

CO1. Analyze the principles of sustainability to solve complex environmental problems following relevant standards/protocols considering society, health, safety and environment.

CO2. Analyze sustainability metrics and assessment tools to solve complex environmental problems following relevant standards and emerging trends considering society, health, safety, environment and economics besides communicating effectively in graphical form.

CO3. Analyze sustainable engineering practices to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO4. Design sustainable engineering applications to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO5. Analyze sustainable urbanization and industrialization principles to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT I–PRINCIPLES OF SUSTAINABILITY (9 periods)**

Emerging challenges, Sustainability and sustainable engineering; Environmental concerns; Social, economic and legal issues; Availability and depletion of natural resources, Disaster resiliency; Multilateral environmental agreements – Basel convention, Clean development mechanism (CDM), Montreal and Kyoto protocols.

**UNIT II–SUSTAINABILITY METRICS AND ASSESSMENT TOOLS (9 periods)**

Sustainability indicators, metrics and assessment tools, Material flow analysis and material budget, Carbon footprint analysis, Life cycle assessment, Streamlined life-cycle assessment (SLCA), Economic input output-life cycle analysis, Environmental health risk assessment, Other emerging assessment tools.

**UNIT III–SUSTAINABLE ENGINEERING PRACTICES (9 periods)**

Sustainable energy engineering, Sustainable waste management, Green and sustainable buildings and infrastructure, Sustainable civil infrastructure, Sustainable remediation of contaminated sites, Climate geoengineering.

**UNIT IV–SUSTAINABLE ENGINEERING APPLICATIONS (9 periods)**

Environmental and chemical engineering projects, Materials engineering projects, Infrastructure engineering projects – Background, Methodology, Goal and Scope, Study area, Technical design, Environmental sustainability, Life cycle assessment, Economic sustainability, Social sustainability, Rating systems – ENVISION, LEED, GRIHA, IGBC; Conclusions.

**UNIT V–SUSTAINABLE URBANIZATION AND INDUSTRIALIZATION (9 periods)**

Sustainable urbanization and industrialization, United Nations sustainable development goals – Right to education, Poverty eradication, Social and technological changes; Industrial Processes - Material selection, Energy efficiency, Pollution prevention and control techniques, Industrial Ecology, Industrial symbiosis.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**


1. Reddy, K.R., Cameselle, C., and Adams, J.A., *Sustainable Engineering: Drivers, Metrics, Tools, and Applications*, John Wiley &Sons, Inc., Hoboken, New Jersey, 2019, 544p (ISBN: 978-1-119-49393-8).
2. Allen, D. T. and Shonnard, D. R., *Sustainability Engineering: Concepts, Design and Case Studies*, Pearson Education, 1st Edition, 2012.


**REFERENCE BOOKS:**


1. Bradley. A.S; Adebayo,A.O., Maria, P.,*EngineeringApplications in Sustainable Design and Developmen*t, Cengage Learning, 1st Edition, 2016.
2. Purohit, S. S., *Green Technology: An Approach for Sustainable Environment*, Agrobios Publication, 1st Edition, 2016.
3. *Energy Conservation Building Code (ECBC) 2007*, Bureau of Energy Efficiency, Govt. of India, New Delhi.
4. Twidell, J. W. and Weir, A. D., *Renewable Energy Resources*, Routledge, Taylor & Francis Group, 3rd Edition, 2015.


**ADDITIONAL LEARNING RESOURCES:**


1. Daniel A. Vallero and Chris Brasier, *Sustainable Design: The Science of Sustainability and Green Engineering*, Wiley-Blackwell, 1st Edition, 2008.
2. Jorge A. Vanegas, *Sustainable Engineering Practice: An Introduction*, Committee on Sustainability, American Society of Civil Engineers, https://doi.org/10.1061/9780784407509, 2004.
3. Mackenthun, K.M., *Basic Concepts in Environmental Management*, CRC Press, Taylor & Francis Group, 1st Edition, 1999.
4. *Environment Impact Assessment Guidelines*, Notification of Government of India, 2006.

## II B. Tech. - II Semester

(19BT50409) **GREEN TECHNOLOGIES**

(Open Elective-2)

(Common to CE, ME, CSE, CSSE, IT, CSE (AI), CSE (DS) and CSBS)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES: --**

**COURSE DESCRIPTION:** Principles of green engineering; Green communications; Green energy; Green computing; Green construction; Green manufacturing.

**COURSE OUTCOMES:** *After successful completion of the course, students will be able to:*

CO1. Analyze energy efficient communication systems such as Telecommunication systems, ICT, Wireless networks and cellular networks by understanding the principles of green communications.

CO2. Understand the impact of conventional energy sources on environment and realize the significance and principles of green energy sources for sustainability.

CO3. Understand the environmental impacts of IT and approaches for Green IT.

CO4. Analyze concepts of sustainable green construction using appropriate tools and techniques following latest developments and considering safety and environment besides communicating effectively in graphical form.

CO5. Demonstrate the environmental impact of traditional manufacturing and explore the need for green manufacturing process promoting sustainability.

**DETAILED SYLLABUS:**

**UNIT I–PRINCIPLES OF GREEN ENGINEERING AND GREEN COMMUNICATIONS (9 periods)**

**Principles of Green Engineering:** Introduction, Definition of green engineering, Principles of green engineering

**Green Communications:** Introduction, Origin of Green Communications, Energy Efficiency in Telecommunication systems, Telecommunication system model and energy Efficiency, Energy saving concepts, Quantifying energy efficiency in ICT, Energy efficiency metrics of green wireless networks, Embodied energy of communication devices- Introduction, The extended energy model, Embodied/Operating Energy of a BS in Cellular network- A Case study; Energy efficient standards for wireline communications.

**UNIT II–GREEN ENERGY (9 periods)**

Introduction, green energy systems - composition, adverse impacts,Green energy and sustainability, the target and solution.Diversification and localization of energy systems, green energy and sustainable development.Energy sources and their availability. Green energy sources - solar energy, wind energy, geothermal energy, ocean energy, biomass and biogas.

**UNIT III–GREEN IT (9 periods)**

Introduction, Awareness to Implementation: Green IT Trends, Green Engineering, Greening by IT: Using RFID for Environmental Sustainability, Smart Grids, Smart Buildings and Homes, Green Supply Chain and Logistics, Enterprise-Wide Environmental Sustainability, A Seven-Step Approach to Creating Green IT Strategy: Balancing the Costs and Benefits of Going Green, Research and Development Directions.

**UNIT IV–GREEN CONSTRUCTION (9 periods)**

**Green Building:** Concept, Necessity, Characteristics, Benefits, Requisites for green building construction, Sustainability, Concept of REDUCE, REUSE, RECYCLE, RETHINK, REPLENISH AND REFUSE (6 R's), Sustainable construction focus point – Site selection, Planning, Water, Energy, Material, Indoor air quality, Construction procedures, case studies of residential and commercial green buildings.

**Vastu:** Concept, History, scientific approach, elements of vastu for selecting a plot.

**Indian Green Building Council:** Introduction to IGBC green homes, Benefits of IGBC, IGBC green home rating system, Introduction to USGBC, LEED rating system, Procedure to get IGBC certification, GRIHA Rating.

**UNIT V – GREEN MANUFACTURING (9 periods)**

Green Manufacturing - Introduction, Background and Definition; Impact of traditional manufacturing in environmental ecology, Need for green manufacturing, Motivation and barriers to green manufacturing, Advantages and Limitations of green manufacturing, Green manufacturing strategies,Green manufacturing and sustainability, Green manufacturing through clean energy supply, Green packaging and Supply chain.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**


1. KonstantinosSamdanis, Peter Rost, Andreas Maeder, MichelaMeo, Christos Verikoukis, *Green Communications: Principles, Concepts and Practice*, John Wiley & Sons, 2015.
2. G.D. Rai, *Non-conventional Energy Sources*, KhannaPublishers, Delhi, 5th Edition,2011.
3. San Murugesan, G.R. Gangadharan, *Harnessing Green IT – Principles and Practices*, John Wiley & Sons Ltd., 2008.
4. Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison, *Green Building Handbook*, Volume 1, E & FN Spon, an imprint of Thomson Science & Professional.
5. J Paulo Davim, *Green Manufacturing: Processes and Systems*, Springer, 2012.
6. David A Dornfeld, *Green Manufacturing: Fundamentals and Applications*, Springer, 2013.


**REFERENCE BOOKS:**


1. Soli J. Arceivala, *Green Technologies for a better future,* McGraw Hill Education (India) Pvt. Ltd, 2014.
2. Marty Poniatowski, *Foundation of Green Information Technology, Prentice Hall, 2009.*
3. Athanasios V Alavanidis, ThomaisVlachogianni, *Green Chemistry and Green Engineering*, SynchronaThemata, 2012.

IV B.Tech. - I Semester

# (16BT70412)GREEN TECHNOLOGIES

(Open Elective)

(Common to EEE, ECE & EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | - | 3 |

**PREREQUISITES:** --

**COURSE DESCRIPTION:**

Principles of green engineering; Green communications; Green energy; Green computing; Green construction; Green manufacturing.

**COURSE OUTCOMES:**

On successful completion of the course, students will be able to

CO1. Deploy conceptual knowledge in green technologies pertaining toengineering practice.
CO2. Analyze various green technologies for engineering practice.
CO3. Provide green solutions to engineering problems.
CO4. Apply various green techniques in the engineering practice.
CO5. Consider health and safety issues while providing green solutions to the society.
CO6. Understand issues related to environment sustainability.
CO7. Apply ethical standards for environmental sustainability in the engineering practice.

**DETAILED SYLLABUS:**

**UNIT-I: PRINCIPLES OF GREEN ENGINEERING AND GREEN COMMUNICATIONS (11 Periods)**

**Principles of Green Engineering:**

Introduction, Definition of green engineering, Principles of green engineering.

**Green Communications:**

Introduction, Origin of Green Communications, Energy Efficiency in Telecommunication systems, Telecommunication system model and energy Efficiency, Energy saving concepts, Quantifying energy efficiency in ICT, Energy efficiency metrics of green wireless networks, Embodied energy of communication devices- Introduction, The extended energy model, Embodied/Operating Energy of a BS in Cellular network- A Case study; Energy efficient standards for wireline communications.

**UNIT-II: GREEN ENERGY (09 Periods)**

Introduction, adverse impacts of carbon emission, control of carbon emission– methods, greenhouse gas reduction – methods, Energy sources and their availability, Green energy for sustainable development. Green energy sources – Solar energy, Wind energy, Fuel cells, Biofuels, Wave and Geothermal energy (Principle of generation only).

**UNIT-III: GREEN IT (09 Periods)**

The importance of Green Information technologies, Strategizing Green Initiatives, Implementation of Green IT, Information Assurance, Communication and Social Media, Regulating Green IT- Laws, Standards and Protocols; RoHS, REACh, WEEE, Legislating for GHG Emissions and Energy Use of IT Equipment, Non-regulatory Government Initiatives, Industry Associations and Standard Bodies, Green Building Standards, Green Data Centres, Social Movements and Greenpeace, Conclusions.

**UNIT-IV: GREEN CONSTRUCTION (09 Periods)**

**Green Building:** Definition, Typical features, Benefits, Requisites for green building construction, Sustainability, Concept of REDUCE, REUSE, RECYCLE, RETHINK, REPLENISH AND REFUSE (6 R's), Sustainable construction focus point – Site selection, Planning, Water, Energy, Material, Indoor air quality, Construction procedures.
**Indian Green Building Council:** Introduction to IGBC green homes, Benefits of IGBC, IGBC green home rating system, Introduction to USGBC, LEED rating system, Procedure to get IGBC certification, GRIHA Rating.

**UNIT-V: GREEN MANUFACTURING (09 Periods)**
Introduction, background, definition, motivation and barriers to green manufacturing, Impact of manufacturing in environmental ecology, Need for green manufacturing, Advantages and Limitations, green manufacturing strategies, Green manufacturing and sustainability, Sustainability tools; Waste stream mapping and application, Green manufacturing through clean energy supply, green lean manufacturing, green packaging and supply chain.

**Total Periods: 47**

**TEXT BOOKS:**


1. KonstantinosSamdanis, Peter Rost, Andreas Maeder, MichelaMeo, Christos Verikoukis, *Green Communications: Principles, Concepts and Practice,*John Wiley & Sons, 2015.
*2.* Soli J. Arceivala, *Green Technologies for a better future,* McGraw Hill Education (India) Pvt. Ltd, 2014.
*3.* San Murugesan, G.R. Gangadharan, *Harnessing Green IT – Principles and Practices,* John Wiley & Sons Ltd., 2008.
4. Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison, *Green Building Handbook*, *Volume 1*, E & FN Spon, an imprint of Thomson Science & Professional.
5. *IGBC Green Homes Rating System Version 1.0* – A bridged reference guide.
6. J Paulo Davim, Green Manufacturing: Processes and Systems, Springer, 2012.
7. David A Dornfeld, Green Manufacturing: Fundamentals and Applications, Springer, 2013.


**REFERENCE BOOKS:**


1. Athanasios V Alavanidis, ThomaisVlachogianni, *Green Chemistry and Green Engineering*, SynchronaThemata, 2012.
2. G.D. Rai, *Non-conventional Energy Sources*, Khanna Publishers, Delhi, 5$^{th}$Edition,2011.
*3.* Marty Poniatowski, *Foundation of Green Information Technology, Prentice Hall, 2009.*
4. R. K. Gautham, *Green Homes*, BS publications, 2009.

## III B. Tech. – I Semester

## (19BT50301) COMPUTER AIDED DESIGN AND MANUFACTURING

(Program Elective)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Computer Aided Machine Drawing Lab and Manufacturing Technology.

**COURSE DESCRIPTION:** Fundamental and conventional CAD processes; Raster scan graphics co-ordinate system; Transformations; Geometric construction models; Curve representationmethods;ComputerControlinNC;GT;CAPP.

**COURSE OUTCOMES:** On successful completion of this course,students will be able to:

**CO1**. Demonstrate the basic concepts of CAD to generate a suitable geometric model of an object.
**CO2**. Analyze algorithms for computer graphics and use geometric models to generate complex contours
**CO3.**Develop the CNC code for complex machining process.
**CO4.**Demonstrate Computer aided manufacturing and computer aided quality control application over manufacturing.
**CO5**. Demonstrate knowledge of automation, robotics and applications.

**DETAILED SYLLABUS:**

**UNIT I– INTRODUCTION TO CAD/CAM AND CIM (10 Periods)**

Computers in Industrial Manufacturing, Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Computer Integrated Manufacturing (CIM), Design process, Product Life Cycle, CAD hardware, CAD Standards-Introduction, classification and Importance of CAD standards. Computer Integrated Manufacturing - Introduction, Types of Manufacturing System, Nature and role of the elements of CM System, CIMS Benefits, Database requirements for CIM.

**UNIT II – COMPUTERGRAPHICS &GEOMTERIC MODELING (10 Periods)**

**ComputerGraphics:**RasterScanGraphics:DDALineAlgorithm,Bresenham'sLine algorithm, Coordinate system, 2D &3DTransformations (Scaling, Translation, Rotation&Reflection)
**Geometric Modeling:** Requirements of Geometric Modeling, Definition to Parametric and Non-parametric representation, Introduction to curve representation, Analytical and Synthetic curverepresentation(Bezier,B-spline&Nurbs).

**UNIT III – COMPUTER NUMERICAL CONTROL (09 Periods)**

Introduction to CNC, CNC Hardware basics (Structure of CNC machine tools, Actuation systems, Feedback devices), CNC Tooling (Automatic tool changers, Work holding, CNCProgramming, Part Programming fundamentals, Manual part programming methods, Preparatory Functions, Miscellaneous Functions, Canned Cycles.

**UNIT IV –COMPUTER AIDED PROCESSPLANNING&QUALITY CONTROL**

**(08 Periods)**

Group Technology: Introduction, Part Family, Classification and Coding, Types of coding systems, Identification systems (RFID, Barcodes), Group Technology Cells, Benefits of Group Technology.Computer Aided Process Planning: Retrieval & Generative Computer Aided Process Planning and CAPP systems, CAPP implementation considerations, Benefits of CAPP.

Computer Aided Quality Control : Introduction, Inspection and Testing, Contact & Non-Contact inspection methods.

**UNIT V – AUTOMATION AND ROBOTICS (08 Periods)**

**AUTOMATION:**Introduction to automation, Elements of automation, Types of automation systems, part transfer methods and mechanisms- flow lines-types.

**ROBOTICS**: Introduction to robotics, Law of robotics, Anatomy, Configuration of robots,Robot end effectors-classification, Robotic joints,grippers.

**Total Periods: *45***

**Topics for selfstudy are included in lesson plan**

**Text Books:**


1. P.N. Rao, *CAD/CAM: Principles and Applications*, TMH, 2004
2. Radhakrishnan and Subramaniah, *CAD/CAM/CIM*, New Age International, 2004
3. Michael E.Mortenson*,GeometricModelling*,wiley 2013


**Reference Books:**


1. Ibrahim Zeid, CAD/CAM Theory and Practice, McGraw Hill,2010.
2. MikellP.Groover, Computer Aided Design & Computer Aided Manufacturing, PearsonEducation,2006.
3. E. Micheal, *Geometric Modelling*, John Wiley &Sons ,3rdedition 2013.

## III B. Tech. – II Semester
## (16BT60301)CAD/CAM

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | -- | 3 |

**PRE-REQUISITES:**
Courses on Computer Aided Machine Drawing Lab and Manufacturing Technology.

**COURSE DESCRIPTION:**
Fundamental and conventional CAD processes; Raster scan graphics co-ordinate system; Transformations; Geometric construction models; Curve representation methods; Computer Control in NC; GT; CAPP.

**COURSE OUTCOMES:**
On successful completion of this course, students will be able to:

CO1. Demonstrate the basic concepts of CAD/CAM to generate a suitable geometric model of an object.
CO2. Analyze the features on an object and develop process planning chart/ part program.
CO3. Model the components and develop part programs for real time applications.
CO4. Evaluate the sequential steps required for computer aided design and manufacturing of components.
CO5. Apply software tools for numerical control of fabrication processes.
CO6. Utilize the safe practices in developing codes for designing and manufacturing components with realistic constraints.

**DETAILED SYLLABUS:**

**UNIT - I: INTRODUCTION TO CAD/CAM (08 Periods)**
Computers in Industrial Manufacturing, Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Computer Integrated Manufacturing (CIM), Design process, Product Life Cycle, CAD Standards-Introduction, classification and Importance of CAD standards.

**UNIT – II: COMPUTER GRAPHICS & GEOMTERIC MODELING (14 Periods)**
**Computer Graphics:** Raster Scan Graphics: DDA Line Algorithm, Bresenham's Line algorithm, Coordinate system, 2D &3D Transformations (Scaling, Translation, Rotation & Reflection).
**Geometric Modeling:** Requirements of Geometric Modeling, Definition to Parametric and Non-parametric representation , Introduction to curve representation, Analytical and Synthetic curve representation(Bezier, B-spline &Nurbs), Introduction to surface representation (Bezier & B-spline), Introduction to Solid representation methods(B-rep & CSG).

**UNIT – III: COMPUTER NUMERICAL CONTROL (07 Periods)**
Introduction to CNC, CNC Hardware basics (Structure of CNC machine tools, Actuation systems, Feedback devices), CNC Tooling (Automatic tool changers, Work holding, CNC Programming-Part Programming fundamentals, Manual part programming methods, Preparatory Functions, Miscellaneous Functions, Canned Cycles.

**UNIT - IV: GROUP TECHNOLOGY &COMPUTER AIDED PROCESS PLANNING (07 Periods)**
**Group Technology:** Introduction, Part Family, Classification and Coding, Types of coding systems, Identification systems (RFID, Barcodes), Group Technology Cells, Benefits of Group Technology.
**Computer Aided Process Planning:** Retrieval & Generative Computer Aided Process Planning systems, Benefits of CAPP.

**UNIT - V: COMPUTER INTERGRATED MANUFACTURING AND COMPUTER AIDED QUALITY CONTROL (09 Periods)**

**Computer Intergrated Manufacturing:** Introduction, Types of Manufacturing System, CIMS Benefits, Introduction to Rapid Prototyping and its types (SLA, SLS, FDM and 3D printing), Advantages, Limitations and applications of RPT. Introduction to Flexible Manufacturing System.

**Computer Aided Quality Control :** Introduction, Inspection and Testing, Contact & Non-Contact inspection methods.

**Total Periods: 45**

**TEXT BOOKS:**


1. P.N. Rao, *CAD/CAM: Principles and Applications*, TMH, 2004.
2. Michel P.Groover, *Computer Aided Design & Computer Aided Manufacturing*, Pearson Education, 2006.


**REFERENCE BOOKS:**


1. Ibrahim Zeid, *CAD/CAM Theory and Practice*, Mc Graw Hill, 2010.
2. Radhakrishnan and Subramanian, *CAD/CAM/CIM*, New Age International, 2004.
3. E. Michael, *Geometric Modeling*, John Wiley & Sons, 3rd Edition 2013.

**III B. Tech. – I Semester**

(19BT50303) **Thermal Engineering-II**

| Int. Marks | Ext.Marks | TotalMarks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

Courses on Engineering Thermodynamics and Thermal Engineering-I.

**COURSEDESCRIPTION:**

Steam Boiler; Classification of Boilers;Working of Steam Boilers; Functions of Various Boiler Mountings and Accessories;Performance parameters of boiler; Characteristics offlowthrough steam nozzles; Working of Steam Condensers and their performance;Cooling water requirements; Steam turbines and their analysis; Compounding and governing; Refrigeration systems; Psychrometry;Air conditioning systems.

**COURSEOUTCOMES:**

On successful completion of this course, students will be ableto:

CO1: Analyze the functional and performance characteristics boiler systems todetermineits performance parameters.

CO2: Analyze the performance characteristic of steam nozzlesand condensersand calculate its performance characteristics.

CO3: Analyze the performance characteristic of steam turbinesusing velocity diagrams and determine its performance characteristics.

CO4: Calculate the performance characteristics refrigeration systems**.**

CO5: Calculate the psychometric properties during psychometric processin air conditioning systems.

**DETAILED SYLLABUS:**

**UNIT - I: STEAM BOILERS (09 Periods)**

Classification of Boilers, Working of Fire Tube Boilers - Simple Vertical Boiler, Cochran Boiler, Cornish Boiler and Locomotive Boiler; Working of Water Tube Boilers–Babcock and Wilcox Boiler, Lamont Boiler and Benson Boiler; Functions of Boiler Mountings and Accessories; Boiler horse power, equivalent evaporation, efficiency and heat balance.

Draught: classification – Height of chimney for givendraught and discharge, condition for maximum discharge,efficiency of chimney – artificial draught, induced and forceddraught

**UNIT-II: STEAM NOZZLES AND CONDENSORS (09 Periods)**

**Steam Nozzles:** Classification, functions, Flow of steam through the Nozzles, Velocity of Steam at the exit of Nozzle- Ideal and Actual expansion through the Nozzle; Discharge through the Nozzle-Condition for maximum discharge through the Nozzle, Critical Pressure Ratio; Nozzle Efficiency and Velocity Coefficient, Wilsons Line.

**SteamCondensers:** Classification, Working of Jet and Surface Condensers, Vacuum Efficiency ,Condenser Efficiency, Sources of air, Effect of air leakage in Condenser-Edward's Air Pump; Cooling Water Requirement.

**UNIT - III: IMPULSE TURBINES AND REACTION TURBINES (9 Periods)**

**Impulse turbine**: Classification of Steam Turbines, Working of De-laval Impulse Steam Turbine, Pressure velocity variations, Combined Velocity diagrams of Impulse turbine,

Effect of friction, Axial thrust, Tangential thrust and Power developed, Compounding and Governing.

**Reaction Turbines:** Working of Parson's Reaction Turbine, Degree of Reaction, Pressure velocity variations and combined velocity diagram of Reaction turbine.

**UNIT-IV:REFRIGERATION (09 Periods)**

Introduction to Refrigeration, Units of Refrigeration, Carnot Refrigerator, COP of a refrigerator, Heat Pump, Air refrigeration System-Working Principle and Essential Components of the Plant – COP – Representation of Cycle on T-S and P-h diagram;Vapour Compression Refrigeration (VCR) System – Working Principle and Essential Components of the Plant – COP – Representation of Cycle on T-S and P-h;Vapour absorption system-Working Principle and Essential Components of the Plant – COP; Introduction to refrigerants.

**UNIT - V: AIR CONDITIONING (09 Periods)**

**Psychrometry:** Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Introduction Air Conditioning Systems-Classification of Air conditioning systems.

**Total Periods: *45***

***Topics for self study are included in lesson plan***

**TEXT BOOKS:**


1. R.K.Rajput, *Thermal Engineering*, Laxmi Publication, 10th Edition,2018
2. Mahesh M. Rathore*, Thermal Engineering,* Tata McGraw-Hill Education, 1st Edition,2010.


**REFERENCE BOOKS:**


1. R.S.Khurmi& J.S. Gupta, Thermal Engineering, S.Chand, 15th Edition, 2015.
2. R.S.Khurmi& J.S. Gupta*, Refrigeration and Air conditioning,* S.Chand, 5th Edition, 2020.

## III B. Tech. – I Semester
## (16BT50305)THERMAL ENGINEERING-II

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | - | 3 |

**PRE-REQUISITES:**
Course on Thermal Engineering-I.

**COURSE DESCRIPTION:**
Concept of Rankine Cycle in Steam Power Plant; Working of Steam Boilers; Functions of Various Boiler Mountings and Accessories; Performance of Boiler parameters and Boiler Draught; Characteristics of flow through steam nozzles; Working of Steam Condensers and their performance; Steam turbines and their analysis; Introduction to gas turbines and jet propulsion.

**COURSE OUTCOMES:**
On successful completion of this course, students will be able to:
CO1. Demonstrate the knowledge on components of thermal power plant and gas turbines.
CO2. Analyze the components of thermal power plants using thermodynamic cycles and velocity diagrams.
CO3. Provide suitable solutions by analyzing the various components of thermal power generation system.
CO4. Conduct an elementary energy audit and develop heat balance sheet for boilers.
CO5. Use Steam Tables and Mollier Chart in solving complex problems of Thermal Engineering.

**DETAILED SYLLABUS:**

**UNIT - I: BASIC STEAM POWER CYCLE AND STEAM BOILERS (10 Periods)**
**Basic Steam Power Cycle:** Rankine Cycle-Schematic Layout, Thermodynamic Analysis; Effect of operating variables on the performance, Reheating and Regeneration, Modified Rankine Cycle.
**Steam Boilers:** Classification of Boilers, Working of Fire Tube Boilers - Simple Vertical Boiler, Cochran Boiler, Cornish Boiler and Locomotive Boiler; Working of Water Tube Boilers - Babcock and Wilcox Boiler, Lamont Boiler and Benson Boiler; Functions of Boiler Mountings and Accessories.

**UNIT - II: PERFORMANCE OF BOILERS AND BOILER DRAUGHT (08 Periods)**
**Performance of Boilers:** Boiler Horse Power, Equivalent Evaporation, Factor of Evaporation and Boiler Efficiency, Heat Balance Sheet.
**Boiler Draught:** Classification - Natural and Artificial Draught; Chimney Height, Condition for maximum discharge through a chimney, Chimney Efficiency.

**UNIT - III: STEAM NOZZLES AND IMPULSE TURBINES (10 Periods)**
**Steam Nozzles:** Classification , functions, Flow of steam through the Nozzles, Velocity of Steam at the exit of Nozzle-Ideal and Actual expansion through the Nozzle; Discharge through the Nozzle - Condition for maximum discharge through the Nozzle, Critical Pressure Ratio; Nozzle Efficiency and Velocity Coefficient, Wilsons Line.
**Impulse Turbines:** Classification of Steam Turbines, Working of Delaval Impulse Steam Turbine, Stage Velocity diagram and Combined Velocity diagrams, Effect of friction, Axial thrust, Tangential Thrust and Resultant Thrust, Power developed, Diagram Efficiency, Condition for Maximum Diagram Efficiency, Compounding and Governing.

**UNIT - IV: REACTION TURBINES AND STEAM CONDENSERS (08 Periods)**
**Reaction Turbines:** Working of Parson's Reaction Turbine, Degree of Reaction, Combined velocity diagram of Reaction Turbines, Condition for Maximum efficiency.

**Steam Condensers:** Classification, Working of Jet and Surface Condensers, Vacuum Efficiency, Condenser Efficiency, Sources of air, Effect of air leakage in Condenser-Edward's Air Pump; Cooling Water Requirement.

**UNIT - V: GAS TURBINES AND JET PROPULSION (09 Periods)**

**Gas Turbines:** Classification of Gas Turbines, Components of simple gas turbine plant-Ideal Gas Turbine Cycle and its deviations with actual cycle; Turbine Work and Efficiency of Simple Gas Turbine Cycle, Condition for Optimum Pressure Ratio, Methods to improve Turbine Work - Inter cooling and Reheating; Methods to improve efficiency - Regeneration.

**Jet Propulsion:** Introduction, Classification of Jet Propulsion devices, Working of Air breathing engines- Turbojet Engine, Turbo Prop Engine, Ram Jet Engine and Pulse Jet Engine; Introduction to Rocket Engine.

**Total Periods: 45**

**TEXT BOOKS:**

1. R.K.Rajput, *Thermal Engineering*, Laxmi Publication,9th Edition,2013.
2. R.S.Khurmi& J.S. Gupta, *Thermal Engineering*, S.Chand, 15th Edition,2015.

**REFERENCE BOOKS:**

1. V.Ganesan, *Gas Turbines*, TMH, 3rd Edition, 2010.
2. R.Yadav, *Thermodynamics and Heat Engines*, Pearson, 7th Edition, 2007.

**III B. Tech. – I Semester**

(19BT50304) **AUTOMOBILE ENGINEERING**

(Professional Elective – 1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:** Thermal Engineering-I

**COURSE DESCRIPTION:**

Basic components and classification of automobiles; Fuel Supply System; Cooling System; Ignition System; Electrical Systems; Electronic Systems; Transmission System; Steering System; Suspension and Braking System.

**COURSE OBJECTIVES:**

**CEO1:** To impart knowledge on automobile systems and components.

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1: Demonstrate the knowledge on vehicle structure, chassis layout and fuel supply systems.

CO2: Demonstrate the knowledge on cooling systems and ignition systemsused in an automobile.

CO3: Demonstrate the knowledge on electrical and electronic systems used in automobile.

CO4: Demonstrate the knowledge on construction and working of transmission systems and steering systems of an automobile.

CO5: Demonstrate the knowledge on construction and working of suspension and braking systemsof an automobile.

**DETAILED SYLLABUS:**

**UNIT I– AUTOMOBILE BASICS AND FUEL SYSTEMS (09 periods)**

Classification of automobiles, Components of a four wheeler automobile, Chassis and body, Rear wheel drive, Front wheel drive, Four wheel drive, Turbo charging, Super charging, Oil filters, Oil pumps.

Fuel system: S.I. Engine - Fuel supply system, Mechanical and electrical fuel pump, Air and fuel filters, Carburetor types; C.I. Engine - Requirements of diesel injection systems, Types of injection systems, Fuel pump, Types of nozzles, Nozzle spray formation, Injection timing.

**UNIT II – COOLING AND IGNITION SYSTEMS (10 periods)**

**Cooling systems:** Necessity of cooling system, Requirements of cooling systems, Types, Natural and Forced Circulation System, Thermostat, Types of radiators, Cooling Fan, Water pump, Antifreeze solutions.

**Ignition systems:** Function of an ignition system, Battery ignition system, Magneto coil ignition system, Electronic ignition system using contact breaker, Capacitive discharge ignition system.

**UNIT-III:ELECTRICAL AND ELECTRONIC SYSTEMS (08 periods)**

**Electrical Systems:** Electrical Systems - Introduction, Charging circuit, Generator, Current – voltage regulator; starting system; Bendix drive mechanism, solenoid switch, lighting systems, Horn, wiper.

**Electronic Systems:** Electronics Systems - Introduction, Electronic Control Unit (ECU), Variable Valve Timing (VVT), Active Suspension System (ASS), Electronic Brake Distribution (EBD), Electronic Stability Program(ESP) Traction Control System (TCS), Global Positioning System (GPS).

**UNIT- IV: TRANSMISSION AND STEERING SYSTEMS (10 periods)**

**Transmission systems**: Types of clutches - Cone clutch, Single and multi plate clutch, Centrifugal clutch; Types of Gear box - Constant mesh, Sliding mesh, Synchromesh gear box; Gear shifting mechanism, Automatic transmission, Propeller shaft, Universal joint, Differential, Real axle arrangement.

**Steering systems**: Requirements and functions of steering system, Layout of steering system, Steering gears, Steering linkages; Under steering, Over steering, Steering ratio, Steering geometry - Camber, Caster, Toe-in, Toe out; Power steering, Wheel alignment and Balancing.

**UNIT-V:SUSPENSION AND BRAKE ACTUATING SYSTEMS (08 periods)**

**Suspension systems**: Introduction, Functions of suspension system, Elements of suspension systems, Rigid axle suspension system, Torsion bar, Shock absorber, Telescopic damper, Independent suspension system.

**Brake actuating systems**: Need and functions of braking system, Classification of brakes, Mechanical, Hydraulic, Pneumatic, Vacuum brake systems.

**Total Periods: *45***

**Topics for self study are included in lesson plan**

**TEXT BOOKS:**


1. Dr. Kirpal Singh, *Automobile Engineering*, Vol.1&Vol.2, Standard Publishers distributor, 12th edition, 2011
2. R.K.Rajput, *Automobile Engineering*, Lakshmi Publication, 2 nd Edition, 2014.


**REFERENCE BOOKS:**


1. V.M.Domkundwar, *Automobile Engineering*, Dhanpat Rai & Co, 1st Edition, 2013.
2. V.Ganesan, *IC Engines*, Tata McGraw-Hill, 3rd Edition, 2007.

## IV B. Tech – I Semester
## (16BT70301)AUTOMOBILE ENGINEERING

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | -- | 3 |

**PRE-REQUISITES:**
Course on Thermal Engineering-I.

**COURSE DESCRIPTION:**
Basic components and classification of automobiles; Fuel Supply System; Cooling System; Ignition System; Emissions from automobiles; Pollution control Techniques; Transmission System; Steering System; Suspension and Braking System.

**COURSE OUTCOMES:**
On successful completion of this course, students will be able to:

CO1. Demonstrate the knowledge on working of various components of an automobile.

CO2. Identify and analyze the various systems and sub systems suitable for an automobile.

CO3. Present the probable solution in the design of fuel systems, cooling and ignition systems, transmission systems, steering systems, suspension and braking systems of an automobile.

CO4. Investigate the complex issues in automobile engineering and provide valid conclusions.

CO5. Use the techniques to estimate pollution from the emissions of automobiles.

CO6. Use the national and international standards to assess the emissions from automobiles considering health and safety.

**DETAILED SYLLABUS:**

**UNIT - I: BASICS OF AN AUTOMOBILE (12 periods)**
Classification of automobiles, Components of a four wheeler automobile, Chassis and body, Rear wheel drive, Front wheel drive, Four wheel drive, Turbo charging, Super charging, Oil filters, Oil pumps.
**Fuel system:** S.I. Engine - Fuel supply system, Mechanical and electrical fuel pump, Air and fuel filters, Carburetor types; C.I. Engine - Requirements of diesel injection systems, Types of injection systems, Fuel pump, Types of nozzles, Nozzle spray formation, Injection timing.
**UNIT - II: COOLING & IGNITION SYSTEMS (10 Periods)**
**Cooling systems:** Necessity of cooling system, Requirements of cooling systems, Types, Natural and Forced Circulation System, Thermostat, Types of radiators, Cooling Fan, Water pump, Antifreeze solutions.
**Ignition systems:** Function of an ignition system, Battery ignition system, Magneto coil ignition system, Electronic ignition system using contact breaker, Capacitive discharge ignition system.
**UNIT - III: EMISSIONS FROM AUTOMOBILES (06 periods)**
National and international Pollution standards, Pollution Control Techniques for SI engines and CI engines, Comparison of electronic catalytic converter and conventional catalytic converter, Alternative energy sources for automobiles, Emissions from alternative energy sources - Hydrogen, Biomass, Alcohols, LPG, CNG, Bio-diesel - Their merits and demerits.
**UNIT - IV: TRANSMISSION & STEERING SYSTEMS (11 periods)**

**Transmission systems:** Types of clutches - Cone clutch, Single and multi plate clutch, Centrifugal clutch; Types of Gear box - Constant mesh, Sliding mesh, Synchromesh gear box; Gear shifting mechanism, Automatic transmission, Propeller shaft, Universal joint, Differential, Real axle arrangement.

**Steering systems:** Requirements and functions of steering system, Layout of steering system, Steering gears,Steering linkages; Under steering, Over steering, Steering ratio, Steering geometry - Camber, Caster, Toe-in, Toe out; Power steering, Wheel alignment and Balancing.

**UNIT - V: SUSPENSION & BRAKE ACTUATING SYSTEMS (06 periods)**

**Suspension systems:** Requirements and functions of suspension system, Elements of suspension systems, Rigid axle suspension system, Torsion bar, Shock absorber, Telescopic damper, Independent suspension system.

**Brake actuating systems:** Need and functions of braking system, Classification of brakes, Mechanical, Hydraulic, Pneumatic, Vacuum brake systems.

**Total Periods: 45**

**TEXT BOOKS:**


1. Dr.Kirpal Singh, *Automobile Engineering*, Vol.1&Vol.2, Standard Publishers distributor, 12th edition, 2011.
2. R.K.Rajput, *Automobile Engineering*, Lakshmi Publication, 2nd Edition, 2014.


**REFERENCE BOOKS:**


1. V.M.Domkundwar, *Automobile Engineering*, Dhanpat Rai & Co, 1st Edition, 2013.
2. V.Ganesan, *IC Engines*, Tata McGraw-Hill, 3rd Edition, 2007.

**III B. Tech – II Semester**

(19BT50305) **COMPRESSIBLE FLUID FLOW**

(Professional Elective – 1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

Courses on Fluid Mechanics and Hydraulics Machinery and Engineering Thermodynamics.

**COURSE DESCRIPTION:**

Fundamentals of compressible flows; Mach number; Effect of Mach number on compressibility; One dimensional isentropic flow; Development and strength of the shock Waves; Supersonic flows; Fanno flow and Rayleigh flow.

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1: Analyze the flow characteristics of compressible flowsby solving governing equations.

CO2: Analyze one-dimensionalflowsin diffusers and nozzles.

CO3: Analyze compressible flow having shock waves and determine the strength of shock waves.

CO4: Apply governing equations to compressible flow through constant area duct with friction.

CO5: Apply governing equations to compressible flow through constant area duct with heat transfer

**DETAILED SYLLABUS:**

**UNIT I – Fundamentals of Compressible Flows (09 periods)**

Introduction to Compressible Flow-Concept of continuum-system and control volume approach-conservation of mass, momentum and energy-stagnation state-compressibility-Entropy relations.Wave propagation-Acoustic velocity-Mach number-effect of Mach number on compressibility-Pressure coefficient-physical difference between incompressible, subsonic, sonic and supersonic flows-Mach cone-Sonic boom-Reference velocities-Impulse function-adiabatic energy equation-representation of various flow regimes on steady flow adiabatic ellipse.

**UNIT II– One Dimensional Isentropic flow (09 periods)**

One dimensional steady isentropic flow-Adiabatic and isentropic flow of a perfect gas-basic equations-Area-Velocity relation using 1D approximation-nozzle and diffuser-mass flow rate-chocking in isentropic flow-flow coefficients and efficiency of nozzle and diffuser-working tables-charts and tables for isentropic flow-operation of nozzle under varying pressure ratios –over expansion and under expansion in nozzles.

**UNIT III - Normal shock Wave (09 periods)**

Irreversible discontinuity in supersonic flow-one dimensional shock wave-stationary normal shock-governing equations-Prandtl-Meyer relations-Shock strength-Rankine-Hugoniot Relation-Normal Shock on T-S diagram-working formula-curves and tables-Oblique shock waves -supersonic flow over compression and expansion corners (basic idea only)

**UNIT IV – Flow in constant area duct with friction(Fanno flow) (09 periods)**

Fanno curve and Fanno flow equations, solution of Fanno flow equations, variation of flow properties, variation of Mach number with duct length, isothermal flow in constant area duct with friction, tables and charts for Fanno flow, Experimental friction coefficients.

**UNIT V – Flow in constant area duct with heat transfer (Rayleigh flow)**

**(09 periods)**

Flow through constant area duct with heat transfer (Rayleigh Flow)-Governing equations-Rayleighline on h-s and P-v diagram-Rayleigh relation for perfect gas-maximum possible heat addition-location of maximum enthalpy point-thermal chocking-working tables for Rayleigh flow.

Compressible flow field visualization and measurement - Shadowgraph-Schlieren technique - interferometer - subsonic compressible flow field - measurement (Pressure, Velocity and Temperature) - Wind tunnels –closed and open type

**Total Periods: *45***

***Topics for self study are included in lesson plan***

**TEXT BOOKS:**

1. S.M.Yahya, *Fundamentals of Compressible Flows*, New age international publication, Delhi, 2018.
2. V. Babu, *Fundamentals of Gas Dynamics, John Wiley & Sons, 2nd Edition, 2008*

**REFERENCE BOOKS:**

1. Robert D. Zucker, Fundamentals of Gas Dynamics, John Wiley & Sons, 2nd Edition, 2002.
2. John. D. Anderson, *Modern Compressible Flow*, Mc Graw Hill.3rd Edition, 2017.

**ADDITIONAL LEARNING RESOURCES:**

1. Fundamentals of compressible fluid dynamics- P. Balachandran, PHI Learning, New Delhi
2. Fluid Mechanics by F.M. White
3. ASME Journal of Fluids Engineering
4. NPTEL Courses
5. Institution of Mechanical Engineers, Part G: Journal of Power and Energy, SAGE Publications.
6. Attending GIAN courses at reputed institutions NITs, IITs and IISc.

**III B.Tech. – I Semester**

**(19BT50307) STATISTICAL INFERENCE AND MODELING**

(Professional elective 1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES :**NIL

**COURSE DESCRIPTION:**

Random vs Non-random sampling;Two tailed and one tailed Hypothesis testing, Type 1 and Type 2 errors, Hypothesis testing using z and t statistics; Completely Randomized design; Simple and Multiple Linear Regression; residual analysis;Decision making under uncertainty - Laplace, Hurwicz and Savage criteria

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to:

| | |
|---|---|
| **CO1** | Apply sampling and estimation procedures to appropriately use and construe complex data. |
| **CO2** | Demonstrate the plausibility of pre-specified ideas about the parameters of the model by Hypothesis Testing |
| **CO3** | Design experiments by ANOVA and determine the existence of a statistically significant difference among several group means. |
| **CO4** | Develop appropriate regression models to predict the desired parameters. |
| **CO5** | Apply non-parametric tests for uncertain distributions and decision analysis to identify feasible and viable decision alternatives |

**DETAILED SYLLABUS:**

**UNIT- I: SAMPLING AND ESTIMATION (08 periods)**

Random vs Non-random sampling, Errors in sampling, Central Limit Theorem, Types of estimates, Estimating population mean using z and t statistics, Confidence interval estimation, Maximum likelihood estimation

**UNIT- II: HYPOTHESIS TESTING (09 periods)**

Procedure for Hypothesis testing, Two tailed and one tailed Hypothesis testing, Type 1 and Type 2 errors, Hypothesis testing using z and t statistics, Chi-square test – Goodness of fit, test of independence and test of homogeneity

**UNIT- III:ANALYSIS OF VARIANCE AND EXPERIMENTAL DESIGNS (09 periods)**

Analysis of variance, Completely Randomized design (One way ANOVA), Randomized Block design, Factorial Design (Two way ANOVA)

**UNIT- IV:REGRESSION MODELING STRATEGIES (10 periods)**

Planning for modeling, Choice of the model, model formulation, Interpreting Modeling parameters, Assessment of model fit, Missing data; describing, Resampling, validating and Simplifying the model; Simple and Multiple Linear Regression, residual analysis, Collinearity, Multiple regression model with two independent variables

**UNIT-V: NON-PARAMETRICSTATISTICSAND STATISTICAL DECISION THEORY**

**(09 periods)**

Runs Test, Mann-Whitney Test, Wilcoxon Test, Kruskal-Walis Test, Friedman Test, Spearman's Rank correlation

Decision making under uncertainty - Laplace, Hurwicz and Savage criteria; Decision making under risk – Expected monetary Value, Expected Opportunity Loss, Expected Value of Perfect Information; Decision trees

**Total Periods: 45**

***Topics for self study are included in lesson plan***

**TEXT BOOKS:**


1. Naval Bajpai, Business Statistics, Pearson, Second Edition 2013
2. Casella and Berger, Statistical Inference, Cengage Learning, 2001


**REFERENCE BOOKS:**


1. Frank E HarrelJr.,RegressionModeling Strategies, Springer, Second Edition, 2006
2. Andrew Gelman and Jennifer Hill, Data Analysis using Regression and multi level/hierarchical models, Cambridge, 2007
3. J K Sharma, Business Statistics, Vikas, Fifth Edition, 2020

## III B. Tech. - I Semester

(19BT50505) **ETHICAL HACKING**

(Open Elective-1)

(Common to CE, ME, CSE, CSSE, IT, CSE (AI), CSE (DS) and CSBS)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PREREQUISITES: -**

**COURSE DESCRIPTION:**

Ethical hacking, Network and computer attacks, Footprinting, Social engineering, Port scanning, System hacking, Sniffers, Denial of service, Hacking web servers, Wireless hacking, Cryptography, Network Protection System.

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1. Demonstrate knowledge on the computer security, social engineering and the intent of ethical hacking.

CO2. Select and apply footprinting and port scanning tools to discover vulnerabilities of the computer system.

CO3. Investigate hacking techniques and tools to maintain computer security.

CO4. Analyze cryptosystems and network protection systems for information security and intrusion prevention.

**DETAILED SYLLABUS:**

**UNIT I -ETHICAL HACKING, NETWORK AND COMPUTER ATTACKS (9 periods)**

**Introduction to Ethical Hacking**: The role of security and penetration testers, Penetration-Testing methodologies, What you can and cannot do legally.

**Network and Computer Attacks:** Malicious software, Trojans, Backdoors, Viruses, and Worms, Protection against malware attacks, Intruder attacks on networks and computers, Addressing physical security.

**UNIT II -TCP/IP CONCEPTS AND SOCIAL ENGINEERING (9 periods)**

**TCP/IP Concepts:** Overview of TCP/IP – Application layer, Transport layer, Internet layer; IP addressing – Planning IP address assignments, IPv6 addressing.

**Social Engineering:** What is social engineering, What are the common types of attacks, Understand insider attacks, Understand identity theft, Describe phishing attacks, Understand online scams, Understand URL obfuscation, Social engineering countermeasures.

**UNITIII -FOOTPRINTING ANDPORT SCANNING (9 Periods)**

**Footprinting:** Using web tools for footprinting, Conducting competitive intelligence, Using domain name system zone transfers.

**Port Scanning:** Port scanning, Using port scanning tools, Conducting ping sweeps, Understanding scripting.

**UNITIV -SYSTEM HACKING (9 Periods)**

System hacking -Password cracking techniques, Types of passwords, Key loggers and other spyware technologies, Escalating privileges, Root kits, How to hide files, Steganography technologies, How to cover your tracks and evidences; Sniffers - Protocols susceptible to sniffing, Active and passive sniffing, ARP poisoning, Ethereal capture and display filters, MAC flooding, DNS spoofing techniques, Sniffing countermeasures; Denial of Service - Types of DoS attacks, How DDoS attacks work, How BOTs/BOTNETs work, Smurf attack, SYN flooding, DoS/DDoS counter measures; Session hijacking - Spoofing vs. hijacking, Types of session hijacking, Sequence prediction, Steps in performing session hijacking, Preventing session hijacking.

**UNITV -CRYPTOGRAPHY, NETWORK PROTECTION SYSTEMS (9 periods)**

**Cryptography:** Understanding Cryptography basics, Symmetric and asymmetric algorithms, Public key infrastructure, Cryptography attacks.

**Network Protection Systems:** Understanding routers, Firewalls, Honeypots.

**Total Periods: 45**

***Topics for Self Study are provided in the Lesson Plan***

**TEXT BOOKS:**


1. Michael T. Simpson, Kent Backman, James E. Corley, *Hands-On Ethical Hacking and Network Defense*, 3rd Edition, Cengage Learning, 2017.
2. Kimberly Graves, *CEH: Official Certified Ethical Hacker Review Guide*, Wiley, 2007.


**REFERENCE BOOK:**


1. Michael Gregg, *Certified Ethical Hacker (CEH) Cert guide*,3rd Edition, Pearson, 2019.

**III B. Tech. - I Semester**

(19BT51207) **AI IN HEALTHCARE**

(Open Elective-1)

(Common to CE, ME, CSE, CSSE, IT, CSE (AI), CSE (DS) and CSBS)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PREREQUISITES: -**

**COURSE DESCRIPTION:** Concepts of Artificial Intelligence (AI) in Healthcare; The Present State and Future of AI in Healthcare Specialties;The Role of Major Corporations in AI in Healthcare;Applications of AI in Healthcare.

**COURSE OUTCOMES:**

Aftersuccessful completion of this course, the students will be able to:

CO1. Understand the fundamental concepts of AI in Healthcare sector.
CO2. Understand the applications of AI in Healthcare specialties.
CO3. Demonstrate AI applications developed by corporate companies.
CO4. Demonstrate knowledge on future applications of Healthcare using AI.
CO5. Understand the principles of AI applications through case studies.

**DETAILED SYLLABUS:**

**UNIT I - INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN HEALTHCARE (08 periods)**

Introduction to AI in Healthcare, Benefits and Risks, AI in the health sector, AI versus Human Intelligence, The future of AI in health sector, AI and Neural networks.

**UNIT II - THE PRESENT STATE AND FUTURE OF AI IN HEALTHCARE SPECIALTIES (10 periods)**

**Artificial Intelligence in:** preventive healthcare, Radiology, Pathology, Surgery, Anesthesiology, Psychiatry, Cardiology, Pharmacy, Dermatology, Dentistry, Orthopedics, Ophthalmology.

**UNIT III - THE ROLE OF MAJOR CORPORATIONS IN AI IN HEALTHCARE (08 periods)**

IBM Watson, The role of Google and Deep mind in AI in Healthcare, Baidu, Facebook and AI in Healthcare, Microsoft and AI in Healthcare.

**UNIT IV - FUTURE OF HEALTHCARE IN AI (10 periods)**

Evidence-based medicine, personalized medicine, Connected medicine,Disease and Condition Management , Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantables, Digital Health and Therapeutics, Education, Incentivized Wellness.Artificial Intelligence, Block chain, Robots, Robot-Assisted Surgery, Exoskeletons, Inpatient Care, Companions, Drones, Smart Places, Smart Homes, Smart Hospitals, Reductionism, Innovation vs. Deliberation.

**UNIT V - APPLICATIONS OF AI IN HEALTHCARE (09 periods)**

**Case Study 1:** AI for Imaging of Diabetic Foot Concerns and Prioritization of Referral for Improvements in Morbidity and Mortality.

**Case Study 2:** Outcomes of a Digitally Delivered, Low-Carbohydrate, Type 2 Diabetes Self-Management.

**Case Study 3:** Delivering a Scalable and Engaging Digital Therapy.

**Case Study 4:** Improving Learning Outcomes for Junior Doctors through the Novel Use of Augmented and Virtual Reality for Epilepsy

**Case Study 5:** Big Data, Big Impact, Big Ethics-Diagnosing Disease Risk from Patient Data.

**Total Periods: 45**

***Topics for Self Study are provided in the Lesson Plan***

**TEXT BOOKS:**


1. Dr.ParagMahajan, *Artificial Intelligence in Healthcare, MedManthra Publications*, First Edition 2019.
2. *ArjunPanesar, Machine Learning and AI for Healthcare Big Data for Improved Health*, Apress Publications, 2019.


**REFERENCE BOOKS:**


1. Michael Matheny, SonooThadaneyIsrani, Mahnoor Ahmed, and Danielle Whicher,*Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril*, National Academy of Medicine Publication, First Edition, 2019.


**ADDITIONAL LEARNING RESOURCES:**

1. https://www.udacity.com/course/ai-for-healthcare-nanodegree--nd320

   (AI for Healthcare).
2. https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare

   (Surgical robots, new medicines and better care: 32 examples of AI in healthcare).
3. https://healthtechmagazine.net/article/2020/02/future-artificial-intelligence-healthcare (Future of Artificial Intelligence in Healthcare).

## II B. Tech. - II Semester

(19BT40307) **MANAGEMENT SCIENCE**

(Open Elective-2)

(Common to CE, ME, CSE, CSSE, IT, CSE (AI), CSE (DS) and CSBS)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:** --

**COURSE DESCRIPTION:** Concepts of Management; Concepts Related to ethics and social responsibility; Human Resource Management; Operations Management; Statistical Process Control; Inventory Management; Marketing; Project Management; Project Crashing.

**COURSE OUTCOMES:** *After successful completion of the course, students will be able to:*

CO1. Demonstrate the concepts of management, its functions and processes used in optimum resource utilization within the context of ethics and social responsibility.

CO2. Apply the concepts of HRM for selection and management of human resources.

CO3. Analyze different operations management problems using quality management tools to produce effective, efficient and adoptable products/services.

CO4. Identify different marketing strategies to maximize enterprise profitability and customer satisfaction within the realistic constraints.

CO5. Develop network models in time-cost tradeoff for effective project management.

**DETAILED SYLLABUS:**

**UNIT I–MANAGERIAL FUNCTION AND PROCESS (10 periods)**

Concept and foundations of management, Evolution of management thought; Managerial functions – Planning, Organizing, Directing and Controlling; Decision-making; Role of manager, managerial skills; Managing in a global environment, Flexible systems management; Social responsibility and managerial ethics; Process and customer orientation; Managerial processes on direct and indirect value chain.

**UNITII–HUMAN RESOURCE MANAGEMENT (8 periods)**

Human Resource challenges; Human Resource Management functions; Human Resource Planning; Job analysis; Job evaluation, Recruitment and selection; Training and Development; Promotion and transfer; Performance management; Compensation management and benefits; Employee morale and productivity; Human Resource Information System.

**UNITIII–OPERATIONS MANAGEMENT (10 periods)**

Fundamentals of Operations Management, Services as a part of operations management; Facilities location and layout; Line balancing; Quality management – Statistical Process Control, Total Quality Management, Six sigma; Role and importance of materials management, Value analysis, Make or Buy decision, Inventory control, Materials Requirement Planning, Enterprise Resource Planning, Supply Chain Management.

**UNITIV–MARKETING MANAGEMENT (8 periods)**

Concept, evolution and scope; Marketing strategy formulation and components of marketing plan; Segmenting and targeting the market; Positioning and differentiating the market offering, Analyzing competition; Product strategy; Pricing strategies; Designing and managing marketing channels; Integrated marketing communications.

**UNIT V–PROJECT MANAGEMENT (9 periods)**

Project management concepts; Project planning – Work Breakdown Structure, Gantt chart; Project scheduling – Critical Path Method, Program Evaluation and Review Technique, Crashing the project for time-cost trade off; Resource Levelling.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**


1. MartandT.Telsang, *Industrial Engineering and Production Management*, S. Chand, 2nd Edition, 2006.
2. Koontz and Weihrich, *Essentials of Management*,TMH, 6th Edition, New Delhi, 2007.


**REFERENCE BOOKS:**


1. O.P. Khanna, *Industrial Engineering and Management*, Dhanpat Rai and Sons,2010.
2. N.D. Vohra, *Quantitative Techniques in Management*, TMH, 2nd Edition, New Delhi.
3. L.M. Prasad, *Principles and practice of Management*, S. Chand and Sons, 2006.

**III B. Tech. – I Semester**

**(19BT50310) ARTIFICIAL INTELLIGENCE AND ROBOTICS**

(Inter disciplinary elective – 1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

Courses on Design of machine elements, Kinematics of machinery, Dynamics of machinery, AI tools lab

**COURSE DESCRIPTION:**

Introduction of Artificial Intelligence; Introduction of Robots classifications; Components; Robot drive mechanisms; Mechanical transmission methods aided in functioning of robots; Forward kinematics; inverse kinematics; Manipulator dynamics; Trajectory planning and avoidance of obstacles; Robot programming; Robot Application in Industry; Future Application and Challenges and Case Studies.

**COURSE OUTCOMES:**

On successful completion of this course, the students will be able to:

CO1: Demonstrate the knowledge on applications of AI, and select search strategies based on application requirement.

CO2: Demonstrate the concepts involved in robot systems.

CO3: Analyze kinematics and dynamics of robots.

CO4: Analyze trajectory planning to avoid obstacles involving sensors and control.

CO5: Develop programming for robotic applications.

**DETAILED SYLLABUS:**

**UNIT- I: INTRODUCTION OF AI (09 periods)**

Artificial Intelligence: Introduction to Artificial Intelligence (AI), History. AI techniques, LISP programming, AI and Robotics, LISP in the factory, sensoring and digitizing function in machine vision, image processing and analysis, training and vision system.

Intelligent Agents: Agents and Environments, the Concept of Rationality, the Nature of Environments, the Structure of Agents.

SLE: State of the Art of AI applications.

**UNIT- II: INTRODUCTION OF ROBOTICS (09 periods)**

Robot, Brief History, Classifications, Laws of Robotics, Robotic system, Robot anatomy, common robot configurations, coordinate system, Joint notation schemes, Work volume, Degrees of freedom, Components, End effectors – Classification of End effectors, Tools as end effectors; Teach pendant, sensors, Specification of robots, Applications, safety measures.

**UNIT- III: MANIPULATOR KINEMATICS & DYNAMICS (10 periods)**

**Manipulator kinematics:** Mathematical Preliminaries on Vectors & Matrices, Homogeneous transformations as applicable to rotation and translation, (D-H) notation, Forward kinematics, Inverse kinematics, Manipulators with two, Three degrees of freedom.

**Manipulator dynamics:** Introduction, Inertia of a Link, Lagrangian formulation for a planar 2R manipulator.

**UNIT-IV: TRAJECTORY PLANNING & SENSORS (10 periods)**

**Trajectory planning:** Trajectory planning and avoidance of obstacles, Path planning, Skew motion, Joint integrated motion, straight line motion.

**Sensors:** Position sensors, Velocity sensors, Tactile sensors, Proximity sensors, Machine vision sensors, Fail safe hazard sensor systems and Compliance mechanism

**UNIT-V: ROBOT PROGRAMMING AND APPLICATIONS (07 periods)**

**Robot programming:** Types, Features of languages and Software packages.

**Robot application:** Robot Application in Industry, Task programming, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges, and Case Studies.

**Total Periods: 45**

**Topics for self study are included in lesson plan**

**TEXT BOOKS:**

T1. Stuart Russell and Peter Nowig, Artificial Intelligence: A Modern Approach, PEARSON Publication, 4th edition, 2020.

T2. M.P.Groover, Industrial Robotics: Technology, Programming, and Applications, Tata McGraw-Hill Edition 2008.

T3. John. J. Craig, Introduction to Robotics: Mechanics and Control, Edition 3, Pearson/Prentice Hall, 2005.

**REFERENCE BOOKS:**

R1. Introduction to Artificial Intelligence and Expert Systems – DAN.W.Patterson, PHI, 2nd edition, 2009.

R2. Richard. D.Klafter, Robotics Engineering: an integrated approach, Prentice-Hall publisher, 1st Edition 1988.

R3. K. S. Fu., R. C. Gonzalez, C. S. G. Lee , Robotics: Control Sensing, Vision and Intelligence International Edition, TATA McGraw Hill, 2008.

## IV B. Tech – I Semester
## (16BT70309)INDUSTRIAL ROBOTICS

(Program Elective-3)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | 0 | 3 |

**PRE-REQUISITES:**
Courses on Matrices and Numerical Methods and Dynamics of Machinery.

**COURSE DESCRIPTION:**
Introduction of Robots classifications; Components; Robot drive mechanisms; Mechanical transmission methods aided in functioning of robots; Forward kinematics; inverse kinematics; Manipulator dynamics; Trajectory planning and avoidance of obstacles; Robot programming; Robot Application in Industry; Future Application and Challenges and Case Studies.

**COURSE OUTCOMES:**
On successful completion of this course, students will be able to:
CO1. Demonstrate the knowledge on concepts of robot, Kinematics and dynamics, Trajectory planning and programming of robot.
CO2. Identify, analyze and interpret various methods and review the contemporary problems of robotics.
CO3. Optimize various robotic configuration parameters to analyze the reverse and forward kinematics.
CO4. Investigate the performance parameters on the complex robotic designs.
CO5. Apply appropriate functional techniques, resources, and programming tools to robotic engineering activities.
CO6. Consider safety issues in designing robots for societal applications.

**DETAILED SYLLABUS:**

**UNIT - I: INTRODUCTION (09 Periods)**

Robot, Brief History, Classifications, Joint notation schemes, Work volume, Degrees of freedom, Components, End effectors - Classification of End effectors, Tools as end effectors; Drive system for grippers - Mechanical, Adhesive, Vacuum, Magnetic; Hooks & scoops, Gripper force analysis and gripper design, Active and Passive grippers.

**UNIT - II: ROBOT DRIVES AND POWER TRANSMISSION SYSTEMS (08 Periods)**

Robot Drive Mechanisms - Hydraulic, Electric-Servomotor, Stepper Motor; Pneumatic drives, Mechanical transmission method - Gear transmission, Belt drives; Cables, Roller chains, Link Rod systems, Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws.

**UNIT - III: MANIPULATOR KINEMATICS & DYNAMICS (10 Periods)**

**Manipulator kinematics:** Mathematical Preliminaries on Vectors & Matrices, Homogeneous transformations as applicable to rotation and translation, (D-H) notation, Forward kinematics, Inverse kinematics, Manipulators with two, Three degrees of freedom.

**Manipulator dynamics:** Introduction, Inertia of a Link, Lagrangian formulation for a planar 2R manipulator.

**UNIT - IV: TRAJECTORY PLANNING & SENSORS (10 Periods)**

**Trajectory planning:** Trajectory planning and avoidance of obstacles, Path planning, Skew motion, Joint integrated motion, straight line motion.

**Sensors:** Position sensors, Velocity sensors, Tactile sensors, Proximity sensors, Machine vision sensors, Fail safe hazard sensor systems and Compliance mechanism

**UNIT - V: ROBOT PROGRAMMING AND APPLICATIONS (08 Periods)**

**Robot programming:** Types, Features of languages and Software packages.
**Robot application:** Robot Application in Industry, Task programming, Goals of AI Research, AI Techniques, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges, and Case Studies.

**Total Periods: 45**

**TEXT BOOKS:**


1. M.P.Groover, *Industrial Robotics: Technology, Programming, and Applications*, Tata McGraw-Hill, 2008.
2. John. J. Craig, *Introduction to Robotics: Mechanics and Control*, Pearson/Prentice Hall, 3rd Edition, 2005.


**REFERENCE BOOKS:**


1. Richard. D.Klafter, *Robotics Engineering: an integrated approach*, Prentice-Hall publisher, 1st Edition, 1988.
2. K. S. Fu., R. C. Gonzalez, C. S. G. Lee, *Robotics: Control Sensing*, Vision and Intelligence, International Edition, Tata McGraw Hill, 2008.
3. 3. Ashitav Ghosal, *Robotics*, *Fundamental Concepts and Analysis*, Oxford Press, 2006.
4. Mittal R.K &Nagrath IJ, *Robotics and Control*, Tata McGraw Hill, 6th Edition, 2007.

**III B. Tech. – I Semester**

**(19BT50311) AUTOMOTIVE ELECTRONICS**

(Inter disciplinary elective – 1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

**A course on thermal engineering-I**

**COURSE DESCRIPTION:**

Electronic control in various systems in automobile; Importance of microcontrollers; Sensors and actuators used in automobile; Electronics engines; Automotive instrumentation in signal conversion and lightening system.

**COURSE OBJECTIVES:**

CEO1: *To impart the knowledge on various* Automotive systems integrated with electronic systems.

CEO2: To develop skills in the analyses of various electronic systems used in automotive.

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1: Demonstrate the knowledge on automotive systems, electronic controls in automobiles.

CO2: Demonstrate the knowledge on automotive grade microcontrollers and components of microcomputer in automobile.

CO3: Demonstrate the knowledge on sensors, actuators, signal conditioning techniques, interfacing techniques and actuator mechanisms used in automotive systems.

CO4: Analyze functional and operational characteristics of electronics interventions in engines.

CO5: Demonstrate the knowledge on automotive instrumentation system.

**UNIT 1- AUTOMOTIVE SYSTEMS**

Introduction, Need for electronic control in automobiles; various sub-systems of automobile: Engine, Transmission System, Steering and Brake Systems; Classification and working of IC engine: Gasoline, Diesel engines, 2-stroke, 4-stroke engines; Engine Control methods: Air-fuel ratio control, Spark timing, Start of fuel injection.

**UNIT II- MICROCOMPUTERS**

Microcomputer: Buses, memory, timing, CPU registers; Microprocessor architecture: Initialization, operation codes, program counter, branch and jump instructions, subroutine. Analog to digital converters and Digital to analog converters, sampling, polling and interrupts, digital filters, lookup table.

**UNIT III- SENSORS AND ACTUATORS**

Speed sensors, Pressure sensors: Manifold Absolute Pressure sensor, knock sensor, Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensors, Position sensors: Throttle position sensors, accelerator pedal position sensors and crankshaft position sensors, Air mass flow sensors. Solenoids, stepper motors and relays.

**UNIT IV- ELECTRONIC ENGINE AND VEHICLE MANAGEMENT SYSTEM**

Electronic engine control: Input, output and control strategies, electronic fuel control system, fuel control modes: open loop and closed loop control at various modes, EGR control, Electronic ignition systems–Spark advance correction schemes, fuel injection timing control. Cruise control system, Antilock braking system, electronic suspension system, electronic steering control, traction control system, Transmission control, Safety: Airbags, collision avoiding system, low tire pressure warning system.

**UNIT V- AUTOMOTIVE INSTRUMENTATION SYSTEM**

Input and output signal conversion, multiplexing, fuel quantity measurement, coolant temperature and oil pressure measurement, display devices- LED, LCD, VFD and CRT, On-board diagnostics (OBD), OBD-II, off-board diagnostics.

**Total Periods: 45**

**Topics for self study are included in lesson plan**

**TEXT BOOKS:**


1. William Bribbens,*Understanding Automotive Electronics*, NewneButterworth-Heinermann,6th Edition, 2002.
2. Crouse W H, *Automobile Electrical Equipment*, McGraw Hill, New York 2005.


**REFERENCE BOOKS:**


1. Bechhold, *Understanding Automotive Electronics*, SAE, 1998.
2. Robert Bosch *Automotive Hand Book*, SAE 5th Edition, 2000.
3. Tom Denton, *Automobile Electrical and Electronic Systems*"Edward Arnold, 3rd Edition, 2004.
4. Eric Chowanietz*, Automotive Electronics*, SAE International, USA, 1995.

**III B. Tech. – I Semester**

**(19BT50312) INDUSTRIAL AUTOMATION AND CONTROL SYSTEMS**

(Inter disciplinary elective – 1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | -- | -- | 3 |

**PRE-REQUISITES:** NIL

**COURSE DESCRIPTION:**

Automation in Production System; Advanced Automation Functions; Material Handling Systems; GT and Cellular Manufacturing; FMS; Industrial Control Systems; AI in manufacturing.

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to:

CO1: Demonstrate knowledge on Industrial automation components and systems used in automated manufacturing industries.

CO2: Design material handling systems for a manufacturing plant based on its working principle and capabilities.

CO3: Analyze transfer lines in automation involving Manufacturing Cells, GT, Cellular Manufacturing, FMS, and FMS.

CO4: Demonstrate the knowledge on control systems in manufacturing.

CO5: Develop mathematical models for manufacturing plants using AI.

**DETAILED SYLLABUS:**

**UNIT- I: INTRODUCTION TO AUTOMATION: (07 periods)**
Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.
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**UNIT- II: MATERIAL HANDLINGSYSTEMS (10 periods)**
Overview of Material Handling Systems, Rotary feeders, oscillating force feeder, vibratory feeder, elevator type and Centrifugal type feeders, Principles and Design Consideration, Material Transport Systems, Storage Systems.

**UNIT-III: AUTOMATION IN MANUFACTURING (09 periods)**
Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines &Transfer Mechanisms, Fundamentals and Analysis of Transfer Lines, product design for automatic assembly.

**UNIT-IV: CONTROL SYSTEM IN MANUFACTURING (09 periods)**
Industrial Control Systems, Process Industries Verses Discrete - Manufacturing, Industries Continuous Verses Discrete Control, Computer Process and its Forms. Sensors Actuators and other Control System Components, Application of control system in manufacturing

**UNIT-V: ARTIFICIAL INTELLIGENCE IN MANUFACTURING (10 periods)**
Introduction/need for system Modeling, Building Mathematical Model of a manufacturing Plant, ModernTools – Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.

(**Total Periods: 45**)

**Topics for self study are included in lesson plan**

**TEXT BOOKS:**

1. Hand book of design, manufacturing and Automation: R.C. Dorf, John Wiley and Sons.
2. Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover, Pearson Education.

**REFERENCE BOOKS:**

1. Industrial Automation: W.P.David, John Wiley and Sons..
2. Computer Based Industrial Control, Krishna Kant, EEE- PHI
3. https://nptel.ac.in/courses/112/104/112104288/
4. https://swayam.gov.in/nd1_noc19_cs83/preview
5. https://www.coursera.org/courses?query=automation

**III B. Tech. I-Semester**

**(19BT50314)PROGRAMMABLE LOGIC CONTROLLER IN AUTOMATION**

(Inter disciplinary elective – 1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**
A course on Basic electrical and electronics engineering

**COURSE DESCRIPTION:**
Introduction to Microprocessors; basic microcontrollers; Assembly language programming concepts; Digital signal controls and processing; Controls for robots in automation.

**COURSE OUTCOMES:**

On successful completion of this course, the students will be able to:

CO 1: Demonstrate the knowledge of the internal architecture of 8085 processor.
CO 2: Demonstrate the architecture and capabilities of microprocessors and microcontrollers.
CO 3: Apply assembly language programs for interrupt and timer programming in different modes.
CO 4: Apply the concept of Z-Transform, digital filters and algorithms for digital control.
CO 5: Demonstrate knowledge of automation using robotics for industrial Applications.

**UNIT – I: INTRODUCTION TO MICROPROCESSORS (9 periods)**
**Introduction:** Number systems, codes. Digital electronics: logic gates, combinational circuits design, flip-flops. Sequential logic circuits design: counters, shift registers.

**Introduction to 8085:** 8085 architecture, registers, ALU, bus systems, 8255 PPI, 8253 programmable timer, ADC and DAC, functional block diagram of 8085.

**UNIT – II: INTRODUCTION TO MICROCONTROLLERS (8 periods)**
**The 8051 architecture :** Introduction, 8051 Micro controller hardware, input / output ports and circuits, external memory, counter and timers, synchronous serial and asynchronous serial communication, interrupts and priorities.

**UNIT – III: ASSEMBLY LANGUAGE PROGRAMMING AND APPLICATIONS**

**(8 periods)**

**Basic Assembly Language Programming Concepts**: Assembly language programming process, addressing modes, instruction set of 8051 microcontroller, assembly language programming, and introduction to C programming.
**Applications:** Interfacing with keyboards, D/A and A/D conversions, serial data communication, programmable timers.

**UNIT – IV: DIGITAL CONTROL (8 periods)**

Introduction to Digital Control: Sampling theorem, signal conversion and processing, Z-Transform, digital filters, implementation of digital algorithm

**UNIT – V: AUTOMATION (12 periods)**

**Automation:** Need for Automation, Robot components, control system concepts, analysis, control of joints, adaptive and optimal control. End effectors, classification, mechanical, magnetic, vacuum, adhesive drive systems and controls, force analysis and gripper design. Direct and inverse kinematics for industrial robots.

**(TOTAL: 45 Periods)**

**Topics for self study are included in lesson plan**

**TEXT BOOKS:**


1. Michael D. Ciletti, M. Morris Mano, Digital Design, 4/e. Pearson Education, 2007.
2. Ramesh S. Gaonkar, Microprocessors, Architecture, Programming and Applications with the 8085, 5/e, Penram, 2011.
3. Thomas R. Kurfess, _Robotics And Automation Handbook_, CRC Press, 2004, ISBN 0-8493-1804-1


**REFERENCE BOOKS:**


1. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited
2. John.F.Wakerly: Microcomputer Architecture and Programming, John Wiley and Sons 1981
3. Kenneth. J. Ayala, The 8051 Microcontroller, 3/e, Cengage Learning, 2004.
4. Digital Control Systems, Benjamin C. Kuo, Oxford University Press ( 2/e, Indian Edition, 2007).
5. Raj Kamal: The Concepts and Features of Microcontrollers, Wheeler Publishing, 2005.
6. Groover M.P. Weiss Mithell Nagel R.N., Odery N.G., "Industrial Robotics, Technology, Programming and Applications", McGraw Hill International Editions, 1986.
7. Klafter,"Robotics Engineering", PHI Pvt. Ltd., New Delhi.

**III B. Tech. – I Semester**

(19BT50315)**SOFT COMPUTING TECHNIQUES IN MECHANICAL ENGINEERING**

(Inter disciplinary elective – 1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:** Nil

**COURSE DESCRIPTION:**

Introduction to Soft computing techniques; Genetic Algorithm; Fuzzy Logic; neural Network; Hybrid soft computing techniques; Application in Mechanical Engineering.

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1: Demonstratethe knowledge on soft computing techniques and their applications.

CO2: Apply the genetic algorithms and their applications in Mechanical Engineering.

CO3: Model the fuzzy systems.

CO4: Analyze various neural network architectures.

CO5: Apply the hybrid soft computing techniques in real life applications.

.

**DETAILED SYLLABUS:**

**UNIT- I: INTRODUCTION TO SOFT COMPUTING (08 periods)**

Evolution of Computing - Soft Computing Constituents – From Conventional AI toComputational Intelligence - Machine Learning Basics

**UNIT- II: GENETIC ALGORITHM (10 periods)**

Introduction, Working cycle of a Genetic Algorithm, Basic operators and Terminologieslike individual, gene, encoding, fitness function and reproduction, Genetic modeling: Significance ofGenetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator,GA optimization problems, JSPP (Job Shop Scheduling Problem), TSP (Travelling SalesmanProblem), Differences& similarities between GA & other traditional methods, Applications of GA.

**UNIT-III: FUZZY LOGIC (09 periods)**

Introduction, Crisp Sets, Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions- Fuzzy Rules andFuzzy Reasoning – Fuzzy Clustering, C-Means clustering, Entropy-based Fuzzy Clustering.

**UNIT-IV: NEURAL NETWORKS (09 periods)**

Introduction, Static Vs Dynamic Neural Networks, training of neural networks, Multi-Layer Feed-Forward Neural Network (MLFFNN), Radial Basis Function Network (RBFN), Self Organizing Map (SOP), Recurrent Neural Networks (RNN).

**UNIT-V:HYBRID SOFT COMPUTING TECHNIQUES (09 periods)**

Working principle of Genetic-Fuzzy systems, Genetic-Neural system, Neuro-fuzzy hybrid systems based on Mamdani Approach, Takagi and Sugeno's approach.

**Total Periods: 45**

**Topics for self study are included in lesson plan**

**TEXT BOOKS:**

1. D. K. Pratihar, *Soft Computing*, Narosa Publications, Revised Edition, 2018
2. S, Rajasekaran& G.A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications*, PHI Publication, 1st Edition, 2009.

**REFERENCE BOOKS:**

1. S.N.Sivanandam, S.N.Deepa, *"Introduction To Genetic Algorithms",* Springer, 2007.
2. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, 1st Edition, 2009.

**ADDITIONAL LEARNING RESOURCES:**
http://nptel.ac.in/courses/106106046/

**III B.Tech. I Semester**
**(19BT503AC) FOUNDATIONS OF ENTREPRENEURSHIP**
(Common to CE, ME, ECE, EEE & EIE)
(AUDIT COURSE)

| L | T | P | C |
|---|---|---|---|
| 2 | - | - | - |

**COURSE PREREQUISITES**: --

**COURSE DESCRIPTION**:

The nature and growth of entrepreneurship;Characteristics of an entrepreneur; Types of Entrepreneurs;Ethics and social responsibility of entrepreneurs;Generating ideas; Opportunity identification; Implementing and managing the venture; Principles of creativity and innovation; Methods of protecting innovation and creativity; Market research; Feasibility analysis;Sources of funding;Preparation of business plan;Start-Ups;Social Entrepreneurship; Rural entrepreneurship.

**COURSE OUTCOMES**:

After successful completion of this course, the students will be able to:

**CO 1:** Demonstrate knowledge on personal attributes that enable best use of entrepreneurial opportunities.
**CO 2:** Apply suitable method to protect creativity and innovation.
**CO 3:** Design and prepare high impact strategic and business plan.
**CO 4:** Analyze the major steps and requirements in order to convert innovative idea into a successful start-up.
**CO 5:** Develop an idea to create a business for social change by identifying social entrepreneurship opportunities.

**DETAILED SYLLABUS:**

**UNIT – I: ENTREPRENEURIAL MINDSET (06 Periods)**

The nature and growth of entrepreneurship, Entrepreneurship and Intrapreneurship, Characteristics of an entrepreneur, Types of Entrepreneurs, Women as an Entrepreneur, Factorsthatcontribute to the success of entrepreneurs, Ethics and social responsibility of entrepreneurs.

**UNIT – II**: **ENTREPRENEURIAL PROCESS (06 Periods)**

Generating ideas, Opportunity identification, Business concepts, Resources (Financial, Physical and Human), Implementing and managing the venture, Harvesting the venture, Harvesting strategies: Absorption of new concept into mainstream operations, Licensing of rights, Family succession, Liquidate (Shut down) venture, Selling the venture, Management Buy-Out (MBO).

**UNIT – III: CREATIVITY AND INNOVATION (06 Periods)**

Principles of creativity and innovation, Disruptive, incremental and open innovations, Nurturing and managing innovation, Methods of protecting innovation and creativity: Intellectual property rights, Branding, Trademarks, Patents, Copyrights, Registered design protection, Trade secrets.

**UNIT – IV: NEW VENTURE PLANNING AND CREATION (06 Periods)**

Market research (venture opportunity screening), Feasibility analysis, Start-up capital;

Sources of funding: equity financing, debt financing (loans, venture funding, angel funding), grants, gifts, bequests and financial statements, Introduction to the business plan, Preparation of business plan.

**UNIT – V: Start-Ups and Social Entrepreneurship (06 Periods)**

**Start-Ups:** Definition to start-up, Start-up activities, Promising start-ups, Venture-backed start-ups, Corporate-supported start-ups.

**Social Entrepreneurship:** Social enterprise-Need - Types - Characteristics and benefits of social enterprises, Rural entrepreneurship.

**Total Periods: 30**

***Topics for self study are included in lesson plan***

**TEXT BOOKS:**


1. Robert D. Hisrich, Mathew J. Manimala, Michael P. Peters, Dean A. Shepherd, *Entrepreneurship*, McGraw Hill Education (India) Private Limited, Eighth Edition, 2013.
2. Marc J Dollinger, *Entrepreneurship: Strategies and Resources*, Pearson, Third Edition, 2003.


**REFERENCE BOOKS:**


1. Vasant Desai, *Dynamics of Entrepreneurial Development and Management,* Himalaya Publ. House, 2004.
2. *Harvard Business Review on Entrepreneurship,* HBR Paper Back.
3. Thomas W. Zimmerer& Norman M. Scarborough, *Essential of Entrepreneurship and small business management,* PHI.

**III B. Tech. II Semester**

**(19BT60301) INDUSTRIAL ENGINEERING AND MANAGEMENT**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES: NIL**

**COURSE DESCRIPTION:**

Management – Concept;Staffing, Leading and Controlling; Leading Effective Teams, Planning and Implementing Change; Allowances and Standard time calculations; Line balancing, Maintenance; Statistical Process Control.

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to:

**CO1** Demonstrate the knowledge on essentials of management theories and approaches by valuing ethics and social responsibility.

**CO2** Analyze organizational structures and formulate leadership strategies for organizational transformation.

**CO3** Apply work study techniques for uniform and enhanced production flow.

**CO4** Analyze maintenance and facility planning problems and solve anomalies in breakdown, availability and redundancy.

**CO5** Apply quality control tools and techniques for acceptance decisions, process adjustments and minimal rework by following quality standards, industry Acts and safety measures.

**DETAILED SYLLABUS:**

**UNIT- I: ESSENTIALS OF MANAGEMENT (09 periods)**

Management – Concept, Process, Theories and Approaches; Management Roles and Skills Functions – Planning, Organizing, Staffing, Leading and Controlling; Decision Making – Concept, Process, Techniques and Tools; Business Ethics, Corporate Social Responsibility and Corporate Governance

**UNIT-II: MANAGEMENT OF ORGANIZATIONAL BEHAVIOUR (09 periods)**

Leadership and management, Classic Motivational Theories, Situational Leadership, Effective Communication, Leading Effective Teams, Planning and Implementing Change, Leadership Strategies for Organizational Transformation.

**UNIT- III:WORK STUDY (09 periods)**

Productivity, Method study – Steps, Charts and Diagrams, Principles of Motion economy; Work measurement – Time study – Rating, Allowances and Standard time calculations; Work sampling, Human Factors and Ergonomics.

**UNIT-IV: FACILITIES PLANNING AND MAINTENANCE (09 periods)**

Types of Production, Plant Location and Layout, Line balancing, Maintenance – Breakdown, Preventive and Predictive; 5S and TPM; Reliability – Series, Parallel, Series-Parallel device configurations, Bath-tub curve, MTBF, MTTR, Availability and Redundancy.

**UNIT- V:QUALITY ASSURANCE AND INDUSTRIAL SAFETY (09 periods)**

Statistical Process Control – Control Charts for Variables and Attributes, Process Capability; Acceptance sampling – Sampling Plans, OC curve; ISO 9000 Standards and Total Quality Management, Benchmarking, Industrial Safety rules, Investigation and

Analysis of Accidents, Indian Factories Act, Workmen Compensation Act and Industrial Disputes Act

**Total Periods: 45**

**TEXT BOOKS**


1. MartandTelsang, **Industrial Engineering and Production Management**, S. Chand, 2nd Edition, 2006
2. Kenneth H. Blanchard, Paul Hersey and Dewey E. Johnson, **Management of Organizational Behaviour**, Pearson, 10th Edition, 2015


**REFERENCE BOOKS**


1. Harold Koontz, Heinz Weihrich, et al, **Essentials of Management**, McGraw Hill, 11th Edition, 2020
2. M I Khan and N A Siddiqui, **Industrial Engineering and Management**, New Age International, 1st Edition, 2018

## III B. Tech. – I Semester
## (16BT50302) INDUSTRIAL ENGINEERING AND MANAGEMENT

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | -- | 3 |

**PRE-REQUISITES:** --

**COURSE DESCRIPTION:**
Concepts and functions of management and organization; selection and analysis of plant location and plant layout; method study and work measurement; inventory, stores and purchase management functions; techniques of statistical process control; Engineering ethics; industrial safety.

**COURSE OUTCOMES:**
On successful completion of this course, students will be able to:
CO1. Demonstrate the knowledge of Industrial Engineering and Management concepts to the Solution of complex engineering problems in an industrial scenario.
CO2. Analyze Industrial problems, identify probable causes and suggest suitable solutions to increase the productivity by reducing the wastages using Principles of Management, and Industrial engineering concepts.
CO3. Design and develop integrated systems that include people, materials, information and equipment that meet the specified needs with appropriate considerations.
CO4. Investigate and employ systematic approach to simplify a complex problem in to a Manageable Sub problem for quicker solution.
CO5. Apply appropriate techniques such as method study, control charts, skills, resources, and modern engineering tools like TQM necessary for engineering practices with an understanding of the limitations.
CO6. Consider safety issues in the providing engineering solutions in industrial scenario.

**DETAILED SYLLABUS:**

**UNIT – I: PRINCIPLES OF MANAGEMENT (09 Periods)**
Concepts of Management and Organization - Evolution of management thought, Taylor's scientific Management, Fayol's principles of Management; Managerial Skills, levels of Management, Systems approach to management, Functions of management, Theory of Motivation - McGregor Theory X and Y; Hierarchy of Needs - Maslow's Theory of Human Needs; Corporate planning process, SWOT Analysis, Corporate Social Responsibility.

**UNIT – II: FACILITIES PLANNING AND MAINTENANCE (10 Periods)**
Types of production, Plant location – definition, factors affecting the plant location, comparison of rural and urban sites; Plant layout – definition, Objectives, Types of plant layout; Plant Maintenance - objectives, functions, Types and Advantages of Plant Maintenance; Types of maintenance, Concepts of Reliability – Definition, MTBF, Series, Parallel and Series-Parallel device configurations; Redundancy.

**UNIT – III: WORK STUDY (07 Periods)**
Productivity, Objectives of Work Study, Method study - Definition, Objectives, Steps involved; Work measurement – definition, Time study, Steps involved, Equipment, Different methods of performance rating, allowances; Work sampling – definition, Steps involved, Standard time calculations.

**UNIT – IV: MATERIALS MANAGEMENT (10 Periods)**
Objectives of Materials Management, Stores management and stores records, Purchase management, Value Analysis, Inventory – Functions, Types, Associated costs, Inventory classification techniques, Factors involved in inventory problem analysis, Inventory costs and deterministic inventory control models - single item inventory control models without shortages, with shortages, with quantity discounts.

**UNIT – V: QUALITY CONTROL & INDUSTRIAL SAFETY (09 Periods)**

**Quality control:** Introduction and Definition of Quality, quality control, process control, Control charts for variables and attributes, Process capability, Acceptance sampling- OC Curve, Sampling Plan; Total Quality Management (TQM)-Total Quality Control, Concepts of TQM, Elements of TQM, Benefits of TQM, Benchmarking.

**Industrial safety:** General Safety Rules, Duties of Plant Safety Inspector, Investigation and analysis of Accidents, Indian Factories Act, Workmen Compensation Act, Industrial Disputes Act.

**Total Periods: 45**

**TEXT BOOKS:**


1. O.P. Khanna, *Industrial Engineering and Management*, Dhanpat Rai Publications, 17th Edition, 2014.
2. MarthandT.Telsang, *Industrial Engineering and Production Management*, S.Chand, 2nd Edition, 2006.


**REFERENCE BOOKS:**


1. Stoner, Freeman, Gilbert, *Management*, Pearson Education, 6th Edition, 2003.
2. M. Mahajan, *Industrial Engineering and Production Management*, Dhanpat Rai Publications, 2ndEdition, 2005.
3. R. Pannerselvam, *Production and Operations Management*, PHI, 3rd Edition, 2012.
4. Ralph M. Barnes, *Motion and Time Study:Design and Measurement of Work*, John Wiley & Sons, 7th Edition, 1980

**III B. Tech. – II Semester**

**(19BT60304) CASTING AND WELDING TECHNOLOGY**

(Professional Elective - 2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

A course on Manufacturing Technology

**COURSE DESCRIPTION:**

Introduction to materials and their manufacturing techniques; Casting methods; Design of pattern and dies; Gating design; Special casting and welding processes; Weld metal characterization; analyzing the properties of weldment; standards and codes followed in industry.

**COURSE OUTCOMES:**

On successful completion of this course, the students will be able to:

CO1: Design patterns, dies, gating systems and riser systems in casting metallurgy considering standards.

CO2: Demonstrate knowledge on modern molding, core making and special casting process.

CO3: Design weld joints in welding metallurgy considering standards.

CO4: Demonstrate knowledge on special welding process.

CO5: Analyze casting and welding process involving advanced processes with environmental considerations.

**DETAILED SYLLABUS:**

**UNIT - I CASTING METALLURGY AND DESIGN (10 periods)**

Casting metallurgy and design-Heat transfer between metal and mould-Solidification of pure metals and alloys-Shrinkage in cast metals-Feeding characteristics of Alloys; Progressive and directional solidification-Elements and types of gating systems; Pressurized and non-pressurized gating; design considerations of gating system; applications. Risers: types and Functions of risers; Computer Aided design for gating and riser systems.

**UNIT II –SPECIAL CASTING PROCESSES (10 periods)**

Special Casting Processes: Investment casting processes; Continuous casting processes; Die casting- low pressure / Gravity, pressure and squeeze; Centrifugal Casting: Calculations of various parameters in centrifugal casting, die temperature, Rotational speeds, advantages, limitations and applications; Defects in various special casting processes.

**UNIT III–WELDING METALLURGY AND DESIGN (9 periods)**

Welding metallurgy and design-Heat affected zone and its characteristics-Weldability of steels, Stainless steel, Aluminium and Titanium alloys-Hydrogen Embrittlement-Lamellar tearing - Residual Stress-Heat transfer and solidification-Analysis of stresses in welded structures - pre and post welding heat treatments-Weld joint design-Welding defects-testing of weldment.

**UNIT IV-SPECIAL WELDING PROCESSES (7 periods)**

Special welding processes-Friction Welding-Friction stir welding-Explosive Welding-Diffusion Bonding-High frequency Induction Welding-Ultrasonic Welding-Electron beam welding-Laser beam welding.

**UNIT V-RECENT ADVANCES IN CASTING AND WELDING (9 periods)**

Recent advances in casting and welding-Layout of mechanized foundry-sand reclamation-Material handling in foundry-Pollution control in Foundry-Recent trends in casting-Computer Aided design of Casting. Automation in welding-WeldingRobots-Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.Introduction to codes and standards, Welding procedure specification,Welding performance qualification.

**Total Periods: 45**

**TEXT BOOKS:**

T1Ravi B, "Metal Casting: Computer Aided Design and Analysis" Prentice Hall ,2005.

T2. R S Parmer,"Welding Engineering Technology", Khanna publishers, 2nd Edition, 2008.

**REFERENCE BOOKS:**

R1. John Campbell, "Casting Practice" Elsevier Science Publishing C0.,2004.

R3. Richard L Little, "Welding and Welding Technology" Tata McGraw Hill, 2004.

R4. ASM Hand Book "Casting", ASM International 1998

**III B.Tech – II Semester**

**(19BT60305) COMPOSITE MATERIALS**

(Professional Elective – 2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

Courses on Basic Engineering Mechanics, Engineering Physics and Materials Science and Engineering

**COURSE DESCRIPTION:**

Composite materials and their classifications; various matrices and reinforcements; manufacturing process of various composites; analyzing the properties of composite materials.

**COURSE OBJECTIVES:**

**CEO1:** To impart the knowledge on characteristics of composite materials and effect of various reinforcements materials in composite materials.

**CEO2:** To develop skill in the analysis of manufacturing process, joining, machining and testing of composite materials.

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

**CO1:** Demonstrate knowledge of composite materials for various engineering applications.

**CO2:** Analyze the effect of fiber length, fiber orientation and concentration on composite properties.

**CO3:** Demonstrate knowledge of manufacturing processes of composites.

**CO4:** Analyze composites for appropriate joining and machining techniques.

**CO5:** Analyze the failure behavior during testing of composite materials.

**DETAILED SYLLABUS:**

**UNIT I-INTRODUCTION TO COMPOSITE MATERIALS (9 periods)**

**Composite Materials:** Definition -Special Features of Composites - Drawbacks of Composites - Classification of Composite Materials: Particle Reinforced Composites - Dispersion Strengthened Composites - Fiber Reinforced Composites -Structural Composites, Processing techniques for Composite materials, Applications and Barriers of Composite Materials.

**UNIT II -RAW MATERIALS FOR COMPOSITE PRODUCTION (9 periods)**

**Matrix Phase:** Types and Functions, **Reinforcements Phase:** Types and Functions, Effect of reinforcement (Fiber length, Fiber orientation and Concentration) on overall composite performance, Fabrics and its types, Prepegs and its types, Preforms and Honeycomb Materials, Molding compounds and its types.

**UNIT III - MANUFACTURING PROCESS OF COMPOSITES (9 periods)**

**Manufacturing Process:** Basic Steps in a Composites Manufacturing Process.

**Manufacturing Processes for Thermoset Composites:** Prepegs Lay-Up Process, Wet Lay-Up Process, Spray-Up Process, Filament Winding Process, Pultrusion Process, Resin Transfer Molding Process, Compression Molding Process, Roll Wrapping Process, Injection Molding Process.

**Manufacturing Processes for Thermoplastic Composites:** Thermoplastic Tape Winding, Thermoplastic Pultrusion Process, Part Fabrication, Autoclave Processing, Diaphragm Forming Process, Injection Molding.

**UNIT IV-JOINING AND MACHINING OF COMPOSITES (9 periods)**

**Joining**: Definition, principles, selection and design guidelines surface preparation, types, advantages, limitations and failures modes in adhesive joints, Mechanical joints: Principles, types, advantages, limitations, design parameters, failure modes

**Machining**: Objectives of Machining, Challenges during Machining of Composites, Failure Mode during Machining of Composites, Cutting tools, Types of machining operations.

**UNIT V-TESTING OF COMPOSITES (9 periods)**

Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing; Non – Destructive testing.

**Total Periods: 45**

**TEXT BOOKS:**


1. Sanjay K. Mazumdar, "Composites Manufacturing - Materials, Product and Process Engineering", CRC Press LLC, 1st edition, USA, 2002.
2. Deborah D. L. Chung, "Composite Materials – Science & Applications", 2nd edition, Springer Verlag, USA, 2009.


**REFERENCE BOOKS:**


1. Daniel B. Miracle and Steven L. Donaldson, ASM Handbook, "Composites", ASTM International, Vol-21, 2001.
2. William. D. Callister, "Materials Science and Engineering-An Introduction", John Wiley and sons, 7thedition, USA, 2007.

**III B. Tech. – II Semester**

**(19BT60307)INTERNAL COMBUSTION ENGINES**

(Professional Elective – 2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

A course on thermal Engineering-I

**COURSE DESCRIPTION:**

Fuel air cycles and actual cycles of internal combustion engines; Combustion phenomena in spark ignition engine; Combustion phenomena in compression ignition engines; Engine friction and lubrication; Non conventional engine.

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1: Demonstrate the knowledge on internal combustion engine systems.
CO2: Analyze fuel air cycles and actual cycles to find the various heat losses.
CO3: Analyze the combustion phenomenon inSI Engines for emissions and study the effect of variables on combustion phenomenon.
CO4: Analyze the combustion phenomenon in CI Engines for emissions and study the effect of variables on combustion phenomenon.
CO5: Demonstrate the knowledge on advances in Internal Combustion engines.

**DETAILED SYLLABUS:**

**UNIT I– INTERNAL COMBUSTION ENGINE SYSTEMS: (9 periods)**

I. C. ENGINES - Classification - Working principles; Engine systems –Fuel, Carburettor,Fuel Injection, Ignition, Cooling and Lubrication System; principle of wankleengine,principles of supercharging and turbo charging.

**UNIT II– FUEL AIR CYCLES AND ACTUAL CYCLES: (9 periods)**

**Fuel Air Cycles:**Assumptions for fuel–air cycles, Reasons for variation of specific heats of gases, change of internal energy and enthalpy during a process with variable specific heats, isentropic expansion with variable specific heats, effect of variable specific heats dissociation, comparison of air standard and fuel air cycles,

**Actual Cycles:**Effect of operating variables, comparison of air standard and actual cycles, effect of time loss, heat loss and exhaust loss in Petrol and Diesel engines.

**UNIT III – COMBUSTION IN S.I. ENGINES (9 periods)**

Stages of combustion in SI engines,combustionparameters,Flame front propagation, Factors influencing the flame speed, abnormal combustion, Phenomenon of knock in S.I engines, factors affecting knock in SI engine, Combustion chambers for SI Engines, Fuel Requirements and Fuel Rating, Emission from SI Enines and its control.

**UNIT IV – COMBUSTION IN C.I. ENGINES (9 periods)**

Stages of combustion in C.I engines,combustion parameters, Factor affecting delay period; Phenomenon of knock in C.I engine,factors affecting knock in CI engine,

comparison of knock in S.I and C.I engines, Combustion chambers for C.I engines, Fuel Requirements and Fuel Rating,Emission from CIEnines and its control.

**UNIT V – ADVANCED IC ENGINES (9 periods)**

Introduction, Common Rail Direct Injection Engine, Dual fuel and Multi-Fuel engine, free piston engine, Gasoline Direct Injection Engine, Homogeneous Compression Ignition Engine, Lean burn Engine, Stratified engine, Variable Compression ratio engineand LHR engines.

**Total Periods: 45**

**TEXT BOOKS:**

1. V. Ganesan, I.C. Engines, TMH, 3rd Edition, 2008.
2. R.K.Rajput, Thermal Engineering, Laxmi publications, 8th Edition, 2010

**REFERENCE BOOKS:**

1. M.LMathur&R.P.Sharma, Internal combustion engines, Dhanpat Rai & Sons, 8th Edition, 2014.
2. Mahesh M Rathore, Thermal Engineering, Tata Mcgrawhill Education, 2010.

## II B. Tech. – II Semester

## (16BT40305)THERMAL ENGINEERING-I

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | -- | 3 |

**PRE-REQUISITES:**

Course on Thermodynamics.

**COURSE DESCRIPTION:**

Comparison of air-standard and actual cycles; Components and working of 2-stroke and 4-stroke engines; Combustion phenomena in spark ignition and compression ignition engines; Performance parameters of an internal combustion engine; Estimating heat losses in an engine; Components and working of reciprocating and rotary compressors.

**COURSE OUTCOMES:**

On successful completion of this course, students will be able to:

CO1. Demonstrate the basic knowledge of an engine and air compressor in developing the analytical models.
CO2. Analyze the combustion and performance parameters of SI engines and CI engines and analyze the performance of air compressors.
CO3. Provide solutions in the design of IC engine.
CO4. Conduct investigation on IC engines for performance improvement and emission reduction.
CO5. Apply new combustion techniques to analyze the combustion in IC Engines.

**DETAILED SYLLABUS:**

**UNIT - I: I.C. ENGINES (09 Periods)**

Classification of I.C. Engines,engine components, Working of two stroke and four stroke engines, Comparison of two stroke and four stroke engines, comparison of SI and CI engines, Valve and port timing diagrams, application of I.C engines, Fuel air cycles **-** Composition of cylinder gases, variable specific heats, dissociation, number of moles Actual cycle - heat loss, time loss, exhaust blow down factors and loss due to rubbing friction.

**UNIT - II: COMBUSTION IN S.I. AND C.I. ENGINES (10 Periods)**

**Combustion in S.I. Engines:** Stages of combustion in SI engines, Flame front propagation, Factors influencing the flame speed, Abnormal combustion, Phenomenon of knock in S.I engines, Combustion chambers for SI Engines, Fuel Requirements and Fuel Rating.

**Combustion in C.I. Engines:** Stages of combustion in C.I engines,Factor affecting delay period; Phenomenon of knock in C.I engine, comparison of knock in S.I and C.I engines, Combustion chambers for C.I engines, Fuel Requirements and Fuel Rating.

**UNIT - III: PERFORMANCE OF I.C. ENGINES (10 Periods)**

**Performance parameters**: Brake power, Indicated power, Friction power, Mean effective pressure, Engine efficiencies, Performance calculations, Heat balance.

**Measurement of Performance parameters:** Brake power **-** Rope brake, hydraulic, Eddy current and swinging field DC dynamometers; Measurement of Friction power - Willian's line method, Morse test, motoring test and retardation test; Air and fuel measurement.

**UNIT - IV: FUELS AND COMBUSTION (06 Periods)**

Introduction, Classification of fuels - Solid fuels, Liquid fuels, Gaseous fuels; Combustion equation, Theoretical air and excess air; Stoichiometric air fuel ratio, Air fuel ratio from analysis of product, Analysis of exhaust gas and flue gas, Internal energy and enthalpy formation, Determination of calorific values of fuels, Adiabatic flame temperature, Chemical equilibrium.

**UNIT - V: AIR COMPRESSORS (08 Periods)**

Air Compressors - Reciprocating Compressors, Effect of Clearance volume in Compressors, Volumetric Efficiency, Single Stage and Multi Stage Compressors, Effect of Inter cooling and Pressure Drop in Multi - Stage Compressors; Working principles of Roots blower, Vane type Blower, Centrifugal Compressor, Axial Flow Compressors.

**Total Periods: 45**

**TEXT BOOKS:**

1. V. Ganesan, *I.C. Engines*, TMH, 3rd Edition, 2008.
2. R.K.Rajput, *Thermal Engineering*, Laxmi publications, 8th Edition, 2010

**REFERENCE BOOKS:**

1. M.L Mathur &R.P.Sharma, *Internal combustion engines*, Dhanpat Rai & Sons, 8th Edition, 2014.
2. Mahesh M Rathore, *Thermal Engineering*, Tata Mcgrawhill Education, 2010.

**III B. Tech. – II Semester**

**(19BT60310) AUTOMOTIVE FUELS AND COMBUSTION**

(Professional Elective – 3)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Thermal Engineering-I

**COURSE DESCRIPTION:**

Basic idea of fuel production procedure, Effect on human health due to pollution caused by I.C engine, Needs of alternative fuel, Types of alternative fuel used in petrol and diesel engine.

**COURSE OUTCOMES:**

On successful completion of this course, students will be able to

CO1: Demonstrate the knowledge of automotive fuels and their storage and handling systems.

CO2: Analyze the desirable characteristics of alternate fuels.

CO3: Analyze composition and characteristics of alternate fuels for enhancing the performance and controlling the emission.

CO4: Demonstrate the knowledge of automotive emission, emission control methods and emission standards.

CO5: Demonstrate the knowledge of automotive emission, emission control methods and emission standards.

**Detailed Syllabus**

**UNIT-I: ATOMOTIVE FUELS (9 periods)**

Introduction, Classification of fuels, Solid Fuels - Origin of coal, Wood and Charcoal, Composition of coal, Properties of different grades of coal, Preparation and storage of coal, Coal washing, Briquetting; Liquid fuels - Introduction, Chemical structure of petroleum-Paraffin Series, Olefin series, Napthalene series, Aromatic series, Production, composition, Petroleum refining; Gaseous fuels -Gasification of liquid fuel, Synthetic fuels.

**UNIT-II: PROPERTIES OF ATOMOTIVE FUELS (9 periods)**

Introduction, Desirable properties of IC engine fuel - Moisture Content, Particle Size and Size distribution, Bulk Specific gravity,Calorific value, Specific gravity, flash and fire point, pour point, metal content, ultimate analysis, proximate analysis, fly ash analysis, Hard grove Grindeability Index, Density, Viscosity, Aromatic Content, Sulphur content, octane number and cetane number.

**UNIT-III: ALCOHOLS AND VEGETABLE OILS AS ALTERNATE FUEL (9 periods)**

**Alcohols:** Introduction to alcohols, Production methods, Properties, use of alcohols in CI and SI engines, Reformulated gasoline for SI engine, Water Gasoline Mixture for SI engine, Alcohol for CI engine, Surface Ignition of Alcohols in CI engine.

**Vegetable oil**: Introduction, Edible and Non Edible oils, Various methods of using Vegetable oil in CI engine, Biodiesel-sources, Preparation of Biodiesel, Characteristics of CI engine with Biodiesel as fuel, Biodiesel oxidation stability, Blending, Preheating, emulsification.

**UNIT-IV:HYDROGEN AND BIOGAS AS ALTERNATE FUEL (9 periods)**

Production methods of hydrogen, Hydrogen Engine, Combustive properties of hydrogen, Problems in hydrogen as fuel, Techniques of using hydrogen in SI and CI engines. Hydrogen storage – safety aspects of hydrogen fuel. Biogas-various production methods-properties,Use in SI and CI engine,Performance and emission characteristics.

**UNIT-V:IC ENGINE EMISSIONS AND CONTROL (9 Periods)**

Engine Exhaust Emissions, Bharat stage emission standards (BSES), Euro norms, Flow in crevices, Leakage Past the exhaust valve, Valve overlap, Deposit on walls, Thermal Converters, Catalytic converters- Sulphur, Cold Start-Ups, CI engines-Particulate traps, Non exhaust Emissions-Evaporative emissions,Emissions control Technique, Modern evaporative emission control system, Crankcase Blowby, Intake manifold return PCV System, EGR, SCR.

**Total Periods : 45**

**TEXT BOOK**


1. AyhanDemirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008.
2. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.


**REFERENCES:**


1. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
2. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.
3. Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).
4. Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels.

**III B. Tech. – II Semester**

**(19BT60311)DESIGN OF PRESSURE VESSELS AND PIPING SYSTEMS**

(Professional Elective–3)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

Courses on Strength of Materials, Design of Machine Elements.

**COURSE DESCRIPTION:**

Material selection, Estimation of stresses; Formulation of fatigue models, Factor of safety; Design of Heads, Covers, Nozzle, Gasket & End closure; Buckling phenomenon, buckling problems and Design of piping layout.

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1: Design cylindrical shells by applying conceptual knowledge of stresses in field problems and selection of materials.

CO2: Analyze safety factors to find fatigue stresses in cylindrical plates to meet ASME Boiler standards.

CO3: Design pressure vessel components such as end closures, bolted flanges and supports to meet the applications.

CO4: Deisgn the pressure vessel cylinders for protection against buckling effects in thick walled cylinders consiedring the standard solutions.

CO5: Design piping layout system consists of Tees, bends, bellows and valves to meet the piping ASME code standard requirements.

**DETAILED SYLLABUS:**

**UNIT- I: DESIGN OF CYLINDRICAL SHELLS (09 periods)**

Introduction to pressure vessels, Design Philosophy, Structural Integrity, material considerations, Stresses in pressure vessels, shrink fit stresses in built up cylinders, autofrettage of thick cylinders, thermal stresses and their significance, methods for determining stresses.

**Design of Cylindrical Shells:** ASME equations - Thin shell equations - Thick shell equations.

**UNIT- II: FATIGUE ASSESSMENT AND DISCONTINUITY STRESSES: (09 periods)**

**Fatigue Assessment:**Introduction to theories of failure; Allowable stress limits in ASME Boiler & Pressure Vessel, Design for cyclic loading, Protection against fracture, S–N curves, Design curves, Cumulative damage. Fatigue, shock, high pressure, high temperature, irradiation, corrosion, and other hostile environments.

**Discontinuity Stresses** -Beams on elastic foundation, Cutouts and Reinforcements.Stress concentration in plate having circular hole due to bi-axial loading, excessive elastic deformation, plastic instability, brittle, rupture and creep. Design of nozzle.

**UNIT-III: END CLOSURES, BOLTED FLANGES & SUPPORTS: (10 periods)**

**End Closures** - Introduction to ASME equations for various types of heads – Hemispherical, flat, ellipsoidal, torispherical, and conical heads.

**Bolted Flanges** - Introduction to bolted flanges, RF and FF flanges - Gasket loading behavior - Application of ASME equations for flange analysis and bolt design.

**Design of Supports:**Design of base plate and support lugs, Support skirts. Types of anchor bolt, its material and allowable stresses, Design for wind load- Design for seismic load- Theory of reinforcement - Design of cone cylinder intersections - Use of codes

**UNIT-IV: DESIGN OF PRESSURE VESSELS FOR BUCKLING LOADS: (08 periods)**

Introduction to Buckling, types of Buckling, Elastic Buckling of circular ring and cylinders under external pressure, Collapse of thick walled cylinders or tubes under external pressure, Effect of supports on elastic Buckling of Cylinders, Design of circumferential stiffeners, Buckling under combined External pressure and axial loading.

**UNIT-V: DESIGN OF PIPING LAYOUT (09 periods)**

Introduction to Piping layout, Flow diagram, piping layout and piping stress analysis; Flexibility factor and stress intensification factor; Design of piping system as per B31.1 piping code.

Introduction to Piping components, bends, tees, bellows and valves.

**Design and analysis of piping systems** – Pipes and tubing under external and internal pressure –design of tube-sheets and tube seats, and use of post-weld heat treatment to affect residual stress in final rupture

**Total Periods: 45**

**TEXT BOOKS:**


1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1987.
2. Somnath Chattopadhyay ,Pressure Vessels: Design and Practice, 1st Edition, CRC Press, 2005.


**REFERENCE BOOKS:**


1. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987.
2. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
3. Stanley, M. Wales, "Chemical process equipment, selection and Design",Buterworths series in Chemical Engineering, 1988.
4. Sam Kannapan, "Introduction to Pipe Stress Analysis". John Wiley and Sons, 1985.
5. Pullarcot, Sunil Kumar, "Practical Guide to Pressure Vessel Manufacturing", CRC Press 2019.
6. Brownell L. E & Young. E. D , Process equipment design, Wiley Eastern Ltd., India,1959.
7. ASME Pressure Vessel and Boiler code, Section VIII Div 1, 2, and 3.
8. ASME B31.1-2016: Power Piping: ASME Code for Pressure Piping, B31, ANSI,2016.
9. Ellenberger P. - 'Pressure Vessels: ASME Code Simplified' - McGraw Hill Company - 2004, 8th Edition.

**III B. Tech. II Semester**

**(19BT60312) MECHANICAL BEHAVIOR OF MATERIALS**

(Professional Elective–3)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | -- | -- | 3 |

**PRE-REQUISITES:**

A course on Material Science and Engineering, Design of Machine Elements

**COURSE DESCRIPTION:**

Elastic and plastic behavior of materials. Strengthening mechanisms,fatigueand its factor affecting, creep and fracture.

**COURSE OUTCOMES:**

On successful completion of this course, the students will be able to:

CO1: Demonstrate the knowledge on mechanism involved in elastic and plastic behavior of materials.

CO2: Apply strengthening mechanism for ferrous and non ferrous materials.

CO3: Analyze Fatigue behavior of components using S-N curve.

CO4: Analyze fractures and mechanics of fractures and determine its parameters.

CO5: Analyze the materials using creep tests for engineering applications.

**DETAILED SYLLABUS:**

**UNIT – I: ELASTIC AND PLASTIC BEHAVIOUR (09 periods)**

Elastic behavior of materials, Hooke's law, plastic behavior, dislocation theory, Burger's vectors and dislocation loops, dislocations in the FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, dislocation climb, intersections of dislocations, Jogs, dislocation sources, multiplication of dislocations, dislocation pile-ups, Slip and twinning.

**UNIT – II: STRENGTHENING MECHANISMS (09 periods)**

Elementary discussion of cold working, grain boundary strengthening. Solid solution strengthening, Martensitic strengthening, Precipitation strengthening, Particulate Strengthening, Dispersion strengthening, Fiber strengthening, Examples of above strengthening mechanisms from ferrous and non-ferrous systems, Yield point phenomenon, strain aging and dynamic strain aging.

**UNIT – III: FATIGUE BEHAVIOUR (09 periods)**

Fatigue: Stress cycles, S-N curves, Effect of mean stress, Factors affecting Fatigue, Structural changes accompanying fatigue, Cumulative damage, HCF / LCF, thermo - mechanical fatigue, application of fracture mechanics to fatigue crack propagation, fatigue testing machines- Pari's Equation, Residual life prediction under Fatigue. Macro, Microstructural features of fatigue fracture.

**UNIT – IV:FRACTURE AND FRACTURE MECHANICS (09 periods)**

Types of fracture, Basic mechanisms of ductile and brittle fracture, Griffith's theory of brittle fracture, Orowan's modification. Izod and Charpy Impacts tests, Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT, Determination of DBTT.

Fracture mechanics-Introduction, Modes of fracture, Stress intensity factor, Strain energy release rate, Fracture toughness and Determination of KIC, Introduction to COD, J integral.

**UNIT V: CREEP BEHAVIOUR AND TESTING (09 periods)**

Creep curve, Stages in creep curve and explanation, Structural changes during creep, Creep mechanisms, Metallurgical factors affecting creep, High temperature alloys, Stress rupture testing, Creep testing machines, Parametric methods of extrapolation. Deformation Mechanism Maps according to Frost/Ashby.

**Total Periods: 45**

**TEXT BOOKS**:


1. Dieter, G. E., Mechanical Metallurgy, McGraw-Hill Co., SI Edition.
2. Thomas H.Courtney, Mechanical Behavior of Materials", McGraw-Hilll, 2nd edition, 2019.


**REFERENCE BOOKS**:


1. Suryanarayana, A. V. K., Testing of Metallic Materials, Prentice Hall India, New Delhi.
2. Marc Andr'e Meyers and Krishan Kumar Chawla, "Mechanical Behavior of Materials" Cambridge University Press, 2009.
3. Prashant Kumar, Elements of Fracture Mechanics, McGraw-Hilll, 2009.

**III B. Tech. – II Semester**

(19BT60313) **NONTRADITIONAL MACHINING PROCESSESS**

(Professional Elective–3)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

Course on Engineering Workshop, Manufacturing Technology

**COURSE DESCRIPTION:**

The course detailsvarious non-conventional manufacturing processes. It consists of manufacturing processes classification and necessity of nonconventionalmanufacturing processes. Also details aboutthe working principle, mechanism of material removal, sources of energy used for materialremoval, the set up/equipment and relativeadvantages and disadvantages.

**COURSE OBJECTIVES:**

CEO1: To impart the knowledge on various advanced machining processes and their behavior, characteristics

CEO2: To build up skills in making of various components with the help of advanced machining processes.

CEO3: To infuse perspective for competent practices followed in machining applications

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

**CO1.** Demonstrate the knowledge on chemical energy based machining processes.

**CO2.** Demonstrate the knowledge on electrochemical energy based machining processes.

**CO3.** Demonstrate the knowledge mechanical energy based machining process

**CO4.** Demonstrate the knowledge on electrical energy based machining processes.

**CO5.** Demonstrate the knowledge on thermal energy based machining process.

**UNIT I - CHEMICAL ENERGY BASED PROCESSES (9 periods)**

Need for non-traditional machining methods, Classification of modern machining processes, Comparative study of different processes, Considerations in process selection, Materials and its applications.

Chemical machining –Fundamentals - Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and Material removal rate - Applications.

**UNIT II- ELECTRO-CHEMICAL ENERGY BASED PROCESSES (9 periods)**

Principles of ECM- Surface Roughness and Material removal rate- Process Parameters – Electro Chemical Grinding - Electro Chemical Honing – Electro Chemical Deburring- Applications.

**UNIT III MECHANICAL ENERGY BASED PROCESSES (9 periods)**

Basic principles, Types of abrasives - Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining.(AJM, WJM, AWJM and USM).

Working Principles – equipment used – Process parameters – Material removal mechanism - Applications.

**UNIT IV ELECTRICAL ENERGY BASED PROCESSES (9 periods)**

Electric Discharge Machining (EDM)- working Principle-Process Parameters-Surface Finish and Material Removal Rate- electrode / Tool – Power and control Circuits-Mechanics of metal removal in EDM, process parameters, Selection of tool electrode and dielectric fluids, Methods of surface finish and machining accuracy, Characteristics of spark eroded surface and machine tool selection,Wire EDM-principle & its applications.

**Unit V THERMAL ENERGY BASED PROCESSES (9 periods)**

**ELECTRON BEAM MACHINING**: Generation and control of electron beam for machining, Theory of electron beam machining, Comparison of thermal and non-thermal processes, Applications, Advantages, Limitations.

**LASER BEAM MACHINING**: General principle and application of laser beam machining, Thermal features, Cutting speed and accuracy of cut, Laser drilling.

**PLASMA ARC MACHINING:** Principle, Metal removal mechanism, Process parameters, Accuracyand surface finish, Applications, Advantages and limitations.

**Text Book(s):**

T1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007

T2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2007.

**Reference Book(s):**

R1. Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.

R2. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.

R3. Paul De Garmo, J.T. Black, and Ronald. A. Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 10th Edition, New Delhi, 2012.

**IIIB. Tech. IISemester**

**(19BT60314) OPTIMIZATION TECHNIQUES**

(Professional elective 3)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

A course on Differential equations and Multi variable calculus

**COURSE DESCRIPTION:**

Introduction to optimization; classical optimization techniques; classification of optimization problems; linear programming; Transshipment and Travelling salesman problem; non-linear programming;un-constrained non-linear programming; constrained non-linear programming; dynamic programming; Genetic Algorithm; Ant Colony Optimization.

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to:

CO1. Model and solve unconstrained optimization problems.
CO2. Apply LP TechniquesandConductSensitivity analysis for real lifeProblems
CO3. Apply Non-Linear Programmingtechniques for real life problems.
CO4. Analyze various complex problems by using Dynamic programming approaches.
CO5. Model and solve complex problems using evolutionary algorithmsto optimize the paramenters.

**DETAILED SYLLABUS:**

**UNIT -I: CLASSICAL OPTIMIZATION TECHNIQUES (09 periods)**

Introduction, Engineering applications of optimization, Statement of an optimization problem, Design vector, Design constraints, Constraint surface, Objective function,Classification of optimization problems,Single variable optimization,Multi variable optimization without constraints,Multi variable optimization with equality constraints - Lagrange multipliers method;Multi variable optimization with inequality constraint - Kuhn Tucker conditions.

**UNIT -II: LINEAR PROGRAMMING (09 periods)**

Introduction, Formulation, Primal Simplex method, Dual simplex method, Sensitivity Analysis, Goal programming

**UNIT –III: NON-LINEAR PROGRAMMING (09 periods)**

One dimensional minimization methods, classification - Fibonacci method, quadratic interpolation method; classification of unconstrained minimization methods - Powell's method, steepest descent method (Cauchy's method); classification of constrained optimization techniques - interior and exterior penalty function methods.

**UNIT –IV: DYNAMIC PROGRAMMING (09 periods)**

Multistage decision processes,Concept of sub optimization and Principle of optimality,Computational procedure in dynamic programming - Calculus method,Tabular

method; Linear Programming problem by dynamic programming approach, Applications - reliability problem, shortest path problem, and capital budgeting problem.

**UNIT- V: EVOLUTIONARY OPTIMIZATION ALGORITHMS (09 periods)**

Introduction to Evolutionary optimization, genetic algorithm-Mathematical Modeling of Genetic algorithm, Ant Colony Optimization, particle swarmOptimization and differential evolution techniques.

**Total Periods:45**

**TEXT BOOKS:**


1. Singiresu S Rao, Engineering Optimization: Theory and Practice, New Age International, 3rdEdition, 2013.
2. A.Ravindran, K.M.Ragsdell, G.V.Reklaitis, Engineering Optimization: Methods and applications, Wiley India Pvt. Ltd., 2nd Edition2006.
3. Dan Simon, Evolutionary Optimization Algorithms, John Wiley & Sons, 2013.


**REFERENCE BOOKS:**


1. C Mohan and Kusum Deep, Optimization Techniques, New Age International Publishers, 1st Edition, 2010.
2. Hamdy A. Taha, Introduction to Operations Research, PHI, 10th edition, 2017.

## III B. Tech. – I Semester

## (19BT50408) MICROELECTROMECHANICAL SYSTEMS

(Inter Disciplinary Elective - 2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Engineering Physics.

**COURSE DESCRIPTION:**
Overview of Micro Electro Mechanical Systems (MEMS), working principles of microsensors and microactuators, materials, micro fabrication processes, MEMS accelerometers, packaging of Microsystems and applications over different fields.

**COURSE OUTCOMES:**
After successful completion of this course, the students will be able to:

CO1: Demonstrate MEMS Components like microsensors and microactuators.(1,2)
CO2: Understand working methodologies of MEMS accelerometers.(3)
CO3: Use micro fabrication techniques and device packaging methods in manufacturing MEMS devices.(4)
CO4: Analyzevarious MEMS devices for engineering applications.(5)

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO MEMS AND MICROSYSTEMS (09 Periods)**
Introduction to MEMS, Energy domains and transducers, sensors and actuators, Microsystems versus MEMS, miniaturization, MEMS materials.

**UNIT-II:MICROSENSORS& ACTUATORS (09 Periods)**
**Microsensors:** Classification of physical sensors, Integrated, Intelligent or Smart sensors, Sensor Principles and Examples: Thermal sensors, Pressure, Flow, Inertial, Gyro sensors, Bio Sensors.
**Microactuators:** Electromagnetic and Thermal microactuation, Mechanical design of microactuators, Microactuator examples, microvalves, micropumps, micromotors.

**UNIT-III: MEMS ACCELEROMETERS (07 Periods)**
Micro accelerometers for MEMS, Temperature and Damping analysis, Piezoelective accelerometer, Piezoresistive accelerometer, Piezocapacitive accelerometer technology.

**UNIT-IV**: **MEMS FABRICATIONAND PACKAGING (12 Periods)**
Review of Fabrication process-Photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition, deposition by Epitaxy, Czochralski process.
Micromachining technology of MEMS, Microstereolithography; Introduction to microsystem packaging, objectives and general considerations in packaging design, three levels of microsystem packaging.

**UNIT-V: MEMS APPLICATIONS (08 Periods)**
Applications of MEMS in the automotive industry, avionics and space applications and commercial applications, RF MEMS, optical MEMS, Introduction to Bio MEMS and microfluidics.

**Total Periods: 45**

**Topics for Self Study are provided in the Lesson Plan**

**TEXT BOOK:**

1. Tai-Ran Hsu, *MEMS & Microsystems, Design and Manufacture*, McGraw Hill Education (India) Pvt. Ltd., 27th reprint, 2018.

**REFERENCE BOOKS:**

1. G.K.Ananthasuresh, K.J.Vinoy, *Micro and Smart Systems*, New Delhi publication, 1st edition, 2011 Education (India) Pvt. Ltd.
2. NitaigourPremchandMahalik, *MEMS*, McGraw Hill Education (India) Pvt. Ltd., 11th reprint, 2016.

**III B. Tech. – II Semester**
(19BT60316) **INSTRUMENTATION AND CONTROL SYSTEMS**
(Inter Disciplinary Elective - 2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

Courses on Engineering Physics, Manufacturing Technology, Machine Tools, Metrology

**COURSE DESCRIPTION:**

Basic Principles of Measurement, Measurement of Displacement, Measurement of Temperature and Pressure, Measurement of Speed, Acceleration, Vibration, force, torque, Power,Stress, Strain, Level And Flow Measurement, Elements of Control systems

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to

CO 1: Demonstrate the knowledge on methods and instruments used for the measurement of Displacement

CO 2: Demonstrate the knowledge on methods and instruments used for the measurement of Temperature and Pressure

CO 3: Demonstrate the knowledge on methods and instruments used for the measurement of Speed, Acceleration, Force, Torque and Power

CO 4: Demonstrate the knowledge on stress and strain measurements Level and Flow measurements.

CO 5: Demonstrate the knowledge of control systems.

**DETAILED SYLLABUS:**

**UNIT I–BASIC PRINCIPLES OF MEASUREMENT (09 periods)**

**Measurement**: Definition - Basic principles of measurement - Measurement systems, generalized configuration and functional descriptions of measuring instruments - examples. Dynamic performance characteristics - sources of error and uncertainity analysis, Classification and elimination of error.

**Measurement of Displacement**: Theory and construction of various transducers to measure displacement - Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

**UNIT II– MEASUREMENT OF TEMPERATURE AND PRESSURE (09 periods)**

**MEASUREMENT OF TEMPERATURE:** Classification - Ranges - Various Principles of measurement - Expansion, Electrical Resistance - Thermistor - Thermocouple - Pyrometers - Temperature Indicators.

**MEASUREMENT OF PRESSURE:** Units - classification - different principles used-Manometers, Piston, Bourdon pressure gauges, Bellows - Diaphragm gauges. Low pressure measurement - Thermal. conductivity gauges - ionization pressure gauges, McLeod pressure gauge.

**UNIT III – Speed, Acceleration, Vibration, Force, Torque and Power Measurement (09 periods)**

**MEASUREMENT OF SPEED:** Mechanical Tachometers - Electrical tachometers - Stroboscope, Noncontact type of tachometer .

**Measurement of Acceleration and Vibration**: Different simple instruments - Principles of Seismic instruments - Vibrometer and accelerometer.

**MEASUREMENT OF FORCE, TORQUE AND POWER**: Elastic force meters, load cells, Torsion meters, Dynamometers.

**UNIT IV – STRESS, STRAIN, LEVEL AND FLOW MEASUREMENT (09 Periods)**

**STRESS & STRAIN MEASUREMENTS:** Various types - electrical strain gauge - gauge factor - method of usage of resistance strain gauge for bending, compressive and tensile strains - usage for measuring torque, Strain gauge Rosettes.

**MEASUREMENT OF LEVEL:** Direct method - Indirect methods - capacitative, ultrasonic, magnetic, cryogenic fuel level indicators - Bubler level indicators.

**FLOW MEASUREMENT:** Magnetic, Ultrasonic, Turbine flow meter, Hot - wire anemometer Laser Doppler Anemometer (LDA).

**UNIT V – SYSTEMS AND THEIR REPRESENTATION (09 periods)**

**ELEMENTS OF CONTROL SYSTEMS:** Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Temperature, speed & position control system

**Total Periods: 45**

**TEXT BOOKS:**


1. D. S. Kumar, Mechanical Measurements and Control, Metropollitan Book, 5th edition, 2015.
2. S. Bhaskar, Basic Principles Measurements, Instrumentation and control systems, Anuradha Agencies, 2014.


**REFERENCE BOOKS:**


1. R.K. Jain, Mechanical and Industrial Measurements, Khance Publications, 12th edition, 2015.
2. Ernesto. Doebelin, Measurement systems application and design, Mc Grawhill Companies, 5th edition, 2003.
3. Bechwith, Marangoni, Lienhard, Mechanical Measurements, Pearson, 6th edition, 2006.

## III B.Tech. - I Semester
## (16BT50307)INSTRUMENTATION AND CONTROL SYSTEMS
(Interdisciplinary Elective-1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | - | 3 |

**PRE-REQUISITES**:

Course on Basic Electrical and Electronics Engineering.

**COURSE DESCRIPTION:**

Fundamentals of instrumentation; Static and Dynamic characteristics; Working principle of instruments used for measurement of level and flow; Basic elements of control systems; Electrical analogue of mechanical, thermal, hydraulic and pneumatic systems; Process contol; PID controllers; Data acquisition systems; Programmable Logic Controllers; SCADA system.

**COURSE OUTCOMES:**

On successful completion of this course, students will be able to:

CO1. Demonstrate the knowledge of fundamentals of instrumentation, measurement and control systems.
CO2. Select the instruments based on the physical considerations for a particular application.
CO3. Build mathematical models of simple physical systems using transfer functions and design logical control systems.
CO4. Investigate the suitable calibration methodology and error analysis related to measuring instruments for real time applications.
CO5. Apply control engineering techniques to the automatic control systems found in modern mechanical systems.

**DETAILED SYLLABUS:**

**UNIT – I: FUNDAMENTALS OF INSTRUMENTATION: (09 Periods)**
Importance of Instrumentation, Types of instruments, Selection of instruments, Static characteristics- Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span and Range; Dynamic performance characteristics - Sources of error, Classification and Elimination of error; Errors in measurement- Types of errors, Effect of component errors, Probable errors, Performance of instruments; Calibration of Instruments - Methods and analysis; Communication Protocols, Hybrid System – HART Communication; Foundation Field Bus – Introduction and classification.

**UNIT — II: MEASUREMENT OF LEVEL AND FLOW (09 Periods)**
**Measuremnet of Level:**
Purpose of level measurement, Vessel characteristics, Categories of level measurement, Direct methods of level measurement – Hook type, Sight glass, Float actuated mechanism; Inferential methods in level measurement- Servo level gauge, Pressure transmitters, Differential head devices, Torque tube displacers, Ultrasonic gauging, Capacitive probes, load cells; Interface level measurement, calibration of level transmitters.
**Measurement of Flow:**
Purpose of measuring flow, Categories of flow measurement, Principles of flow measurement, Working and applications of Magnetic flow meter, Turbine flow meter, Vortex shedding flow meter, Mass flow meter, Ultrasonic flow meter, Flow measurement device selection criteria, Calibration procedures for flow meters.

**UNIT - III: CONTROL SYSTEMS: (09 Periods)**

Introduction, Basic elements of control system, Open loop control system, Closed loop control system, Manually controlled closed loop systems, Automatic controlled closed loop systems, Basic elements of a servo mechanism - Electrical analogue of mechanical, Thermal, Hydraulic and Pneumatic systems; Transfer functions of elements, systems and processes, Transient and steady state response of control systems, effect of various types of control actions on dynamic performance, Stability of control systems.

**UNIT - IV: PROCESS CONTROL (09 Periods)**

Process control symbols and hardware components of a control loop, Characteristics of industrial processes – Integrating processes, Inverse acting processes, First order Dead Time Model, PID Controllers – Types, Design, Anaysis, PID controller tuning procedures; Applications of Cascade/feedforward control, Split range control and inferential control.

**UNIT - V: DATA ACQUISITION SYSTEMS, PROGRAMMABLE LOGIC CONTROLLERS, SCADA (09 Periods)**

**Data Acquisition Systems:** Basic architecture, Various elements/subsystems of a data acquisition system, General telemetry systems.

**Programmable Logic Controllers:**Architeture and functionality of PLCs, Different programming languages and operations of PLCs.

**SCADA:** Basic elements of SCADA systems, SCADA architecture-Monolithic, Distributed, Networked systems.

**Total Periods: 45**

**TEXT BOOKS:**


1. K. Padma Raju, Y.J. Reddy, *Instrumentation and Control Systems*, McGraw Hill Education (India) Private Limited, 1st Edition, 2016.
2. Dr.R.K.Rajput, *Mechanical Measurements and Instrumentation(Including Metrology and Control Systems)*, Katson Books, 2nd Edition, 2015.


**REFERENCE BOOKS:**


1. B.C.Nakra, K.K. Chaudhry, *Instrumentation Measurement and Analysis*, McGraw Hill Education (India) Private Limited, 4th Edition, 2016.
2. I.J. Nagrath and M.Gopal, *Control System Engineering*, New Age International Publishers, 5th Edition, 2007.

**III B. Tech. – II Semester**

**(19BT60317) HYDRAULICS AND PNEUMATICS**

(Inter Disciplinary Elective - 2)

| Int. Marks | Ext.Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

Courses on Fluid Mechanics and Basic Electrical and Electronics Engineering

**COURSE DESCRIPTION:**

Basic fluid power system; Hydraulic components and its use; Hydraulic circuits and its application; Fundamentals of pneumatics; Pneumatic components and its use; Pneumatic circuits; Application; Design of hydraulic and pneumatic systems for various applications; Logic gates, PLC in Pneumatics.

**COURSE OBJECTIVES:**

CEO1: To impart the knowledge of hydraulic and pneumatic systems..

CEO2: To develop skills in analysis, design and development of components, devices and equipment of hydraulic and pneumatic systems.

**COURSE OUTCOMES:**

On successful completion of this course, students will be able to:

**CO1.** Demonstrate the knowledge on basic components and mechanisms of fluid power systems.

**CO2**. Analyze functional characteristics of valves and conditioners used in industrial applications.

**CO3**. Design the pneumatic and hydraulic circuits for domestic and industrial problems.

**CO4** Apply suitable logic gates to control the fluid power system

**DETAILED SYLLABUS:**

**UNIT-I : FUNDAMENTALS OF FLUID POWER (08 Periods)**

Fluid power, Fluid power systems, Fluid power physics; **Pumps:** Pumps, pumping theory, pump classification: Rotary, Reciprocating pumps, gear pumps (internal and external Gear pumps) and piston pumps.

**Actuators:** Cylinders and its classification.

**Pressure Control Valves:** Relief valves, Pilot operated relief valve, Poppet relief valve, Pressure sequence valve, Pressure reducing valve, unloading valve, Counter balance valve, Brake valve

**UNIT-II: VALVES & CONDITIONERS (08 Periods)**

**Directional control valves (DCVs):** Poppet valve, Spool valves, Check valves, Two-way Direction Control Valves, Four-way valves, Pilot operated DCV.

**Flow Control valves:** Classification of flow control valves,Flow control methods: Meter-in circuit, Meter-out circuit and Bleed-off circuit.

**Fluid Conditioner:** Filters, Heat exchangers, Reservoirs,

**Accessory Components:** Accumulators, Pressure switches, Pressure gauges, Flow meters, manifolds, Pressure intensifier.

**UNIT -III: HYDRAULIC & PNEUMATICS (12 Periods)**

Hydraulic Symbols: Flow lines, Reservoirs, Pumps, Directional Control Valves, Flow control valves, Pressure Control valves, Motors, Check valves, Cylinders, Filters, Heat exchanges and accumulator, Basic hydraulic circuits of single and double acting cylinder circuit.

**Pneumatics:**Units, Fundamentals of air, Air compressors and its types, Reservoirs or Air receiver, Safety relief valve, Pressure switches, Air dryers, Air distribution, Air filters, Air regulators, Air lubricators.

**UNIT - IV: PNEUMATIC ACTUATORS AND CIRCUITS (10 Periods)**

**Pneumatic actuators:** Actuators and Output devices, Direction Control Valves(DVC): 2/2 way valve, 3/2 –Way valve, 4/2-Way valve, 4/3- valve, 5/2 –way valve, and 5/3-way valve, Non-Return Valve(NRV), Flow control valves, Mufflers.

**Circuits:** Control of single acting cylinder, Manual controlled double acting cylinder, Air pilot control of double acting actuator, Semi automatic control of a double acting actuator.

**UNIT - V: LOGIC CONTROLS IN FLUID POWER SYSTEMS (07 Periods)**

Position sensors, Back pressure sensors, Proximity sensors, Pneumatic limit valves, limit switches, pressure sensor, Switching elements - Pneumatic valve functions of AND, NOT, and OR GATE, Applications of Fluidics, Examples of Pneumatic Cylinder sequencing circuit using logic gates.PLC in fluid power applications (block diagram of PLC only)

Total Periods: 45

**TEXT BOOKS:**


T1. Srinivasan.R, Hydraulic and Pneumatic controls, McGraw Hill Education, 2nd Edition, 2006.

T2. ShanmugaSundaram. K, Hydraulic and Pneumatic Controls, S. Chand & Co, 1st Edition, 2019


**REFERENCE BOOKS:**


R1. Majumdar S. R., Oil Hydraulics Systems Principles and Maintenance, McGrawHill Education, 1st Edition, 2000.

R2. Majumdar S.R., Pneumatic systems–Principles and Maintenance, McGraw Hill Education, 2nd Edition, 2001.

## III B. Tech. – II Semester
## (16BT60305)HYDRAULICS AND PNEUMATICS

(Common to ME & EIE)
(Program Elective-1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | -- | 3 |

**PRE-REQUISITES:** Courses on Fluid Mechanics and Basic Electrical and Electronics Engineering

**COURSE DESCRIPTION:** Basic fluid power system; Hydraulic components and its use; Hydraulic circuits and its application; Fundamentals of pneumatics; Pneumatic components and its use; Pneumatic circuits; Application; Design of hydraulic and pneumatic systems for various applications; Electro Pneumatics; Logic gates.

**COURSE OUTCOMES:** On successful completion of this course, students will be able to:

CO1. Demonstrate the basic mechanism of fluid power systems and automation.
CO2. Identify and analyze engineering problems in automated environment.
CO3. Design the pneumatic and hydraulic circuits for domestic and industrial problems.
CO4. Investigate the issues related to the design and manufacture of pneumatic and hydraulic systems.
CO5. Use modern tools available in automation to enhance the productivity.
CO6. Deploy the best way of implementing the automation to have eco-friendly environment and sustainable development.

**DETAILED SYLLABUS:**

**UNIT - I: FUNDAMENTALS OF HYDRAULIC POWER SYSTEMS. (08 Periods)**

Fluid Power Fundamentals,Advantages and Application. Pascal's law, Viscous oils, properties. Components of hydraulic systems- Pumps, Gear pump, Vane pump, and Piston pump; Pumping theory, Actuators –Single acting, Double acting, Tandem, Rod less; Accumulators, Intensifiers.

**UNIT - II: HYDRAULICCONTROL COMPONENTS AND DESIGN OF CIRCUITS (09 Periods)**

Directional control valves (DCVs), Pressure control valves, Flow control valves, Shuttle valve, Check valve, Sequence valve, Solenoid valve, and Relay, ISO/ANSI symbols, Simple hydraulic circuits, ladder diagram.

**UNIT - III: FUNDAMENTALS OF PNEUMATICS (09 Periods)**

Pneumatic system components, Compressors, Filters, Regulator, Lubricator unit (FRL UNIT), Driers, Valves, Pressure control valve, Flow control valve, Quick exhaust valve, direct control valves, Time delay valve, Memory valve, Shuttle valve, Twin pressure valve, Solenoid valves and Pneumatic cylinders, ISO/ANSI symbols.

**UNIT - IV: DESIGN OF PNEUMATIC CIRCUITS (10 Periods)**

Pneumatic circuits, Speed control circuits, Multi- Cylinder Application by Coordinated and sequential motion control, Motion and control diagrams, Cascading method-principle, and Practical application (up to two cylinders)

**UNIT - V: ELECTRO PNEUMATICS AND LOGIC GATES (09 Periods)**

**Electro- Pneumatic:** Principles - Signal input and output, Pilot assisted solenoid control of directional control valves, Use of relay and contactors.

**Logic Gates:** Introduction and use of Logic gates in pneumatic applications, Practical Examples.

**Total Periods: 45**

**TEXT BOOKS:**

1. Srinivasan.R, *Hydraulic and Pneumatic controls*, McGraw Hill Education, 2nd Edition, 2006.
2. Shanmugasundaram.K, *Hydraulic and Pneumatic Controls*, S. Chand & Co, 1st Edition, 2006

**REFERENCE BOOKS:**

1. Majumdar S.R., *Oil Hydraulics Systems- Principles and Maintenance*, McGrawHill Education, 1st Edition, 2000.
2. Majumdar S.R., *Pneumatic systems – Principles and Maintenance*, McGraw Hill Education, 2nd Edition, 2001.

**III B. Tech. - II Semester**

(19BT60318) **INDUSTRIAL INTERNET OF THINGS**

(Inter Disciplinary Elective - 2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

**COURSE DESCRIPTION:**Introduction to the Industrial Internet;IIoT Reference Architecture ; Design of Industrial Internet Systems ; Modern Communication Protocols, WirelessCommunicationTechnologies,The Access Network, AccessNetworks Connecting , Defining Industry 4.0 ,Introducing the Smart Factory, Smart Factories in Action, IOT – A Market Perspective, Technical Design constraints

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to:

CO1: Analyze the functional, informational, and operational characteristics of IoT and IIOT architectures.

CO2: Design industrial internet systems encompassing access network technology and protocols.

CO3: Apply design principles, characteristics, and building blocks of Industry 4.0. for innovative manufacturing applications.

CO4: Demonstrate knowledge of IoT market perspective and Security issues in smart manufacturing.

CO5: Apply real-world design constraints for solving problems encountered in smart manufacturing.

**DETAILED SYLLABUS:**

**UNIT-I: IoT and IIoT Reference Architecture (09 Periods)**

**Introduction**: Introduction to the Internet of Things (IoT). Architecture, Enabling Technologies, Applications.

**IIoT Reference Architecture**:Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

**UNIT-II:Design of Industrial Internet Systems and Access Network Technology & Protocols (09 Periods)**

**Design of Industrial Internet Systems:** The Concept of the IIoT, The Proximity Network, WSNEdge Node, Legacy Industrial Protocols, Modern Communication Protocols, WirelessCommunication Technologies, Proximity Network Communication Protocols, Gateways.

**Access Network Technology and Protocols**: The Access Network, AccessNetworks Connecting Remote Edge Networks.

**UNIT-III: Industry 4.0 and Smart Factories (09 Periods)**

**Industry 4.0:** Defining Industry 4.0, Four Main Characteristics of Industry 4.0, TheValue Chain, Industry 4.0 Design Principles, Building Blocks of Industry 4.0, SmartManufacturing.

**Smart Factories:** Introducing the Smart Factory, Smart Factories in Action, Importance of SmartManufacturing, Real-World Smart Factories - GE's Brilliant Factory, Airbus: Smart Tools andSmart Apps, Siemens' Amberg Electronics Plant (EWA), Industry 4.0: The Way Forward

**UNIT-IV:IoT Market perspective and security issues in manufacturing**

**(09 Periods)**

**IoT Market perspective:** M2M to IoT – A Market Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, emerging industrial structures for IoT, The international driven global value chain and global information monopolies.

**SecurityissuesinManufacturing:** PLCs and DCS, Securing the OT,Network Level: Potential Security Issues, System Level: Potential Security Issues, Identity Access Management

**UNIT-V: Real World IoT Design Constraints and Industrial Automation**

**(9 Periods)**

**Real-World IOT Design Constraints-** Introduction, Technical Design constraints-hardware components, Data representation and visualization, Interaction and remote control.

**Industrial Automation-** Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things,

**Total Periods: 45**

**TEXT BOOK**:


1. Alasdair Gilchrist,Industry 4.0: The Industrial Internet of Things,Apress Publications, 2016.

2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.


**REFERENCE BOOKS**:


1. Giacomo Veneri and Antonio Capasso, Hands-on Industrial Internet of Things :Createapowerful Industrial IoT infrastructure using Industry 4.0,Ingram Academic Services, 2018.

2. Vijay Madisetti and ArshdeepBahga, Internet of Things A Hands-On-Approach,OrientBlackswan Private Limited, 2015.

3. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach toConnectingEverything", 1st edition, Apress Publications, 2014.

**III B Tech - II Semester**

**(19BT60319) MACHINERY FAULT DIAGNOSIS AND SIGNAL PROCESSING**

(Inter Disciplinary Elective–2)

| Int. Marks | Ext. | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**Pre-requisites:**

Courses on Basic Engineering Mechanics, Kinematics of Machinery and Dynamics of Machinery.

**Course Description:**

Introduction to Condition Based Maintenance, Types and Benefits of Vibration Analysis; Basic Signal Processing Techniques- visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, crack monitoring, thickness monitoring, noise and sound monitoring;Fault Detection- Vibration Criteria- Use of Frequency Spectra- CPB Spectrum;Diagnostic Techniques- Gear Diagnostics techniques- Bearing Diagnostics;Vibration Monitoring- vibration data collection, instruments, measurement location, time domain analysis, frequency domain analysis.

**Course Objectives:**

CEO1: To impart the knowledge on condition-based maintenance, signal processing techniques, fault detection methods in rotating machines.

CEO2: To develop skill in the analysis of undesirable effects of unbalances in rotating and reciprocating machines using time domain analysis, frequency domain analysis and time-frequency domain analysis.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Apply maintenance and condition monitoring techniques to machines.

CO2: Apply signal processing techniques to components of machines.

CO3: Analyze and correct the Machinery faults using fault Trending and Prognostics tools.

CO4: Analyze machine elements using various Diagnostic Techniques

CO5: Analyze characteristics of vibration using suitable monitoring techniques.

**DETAILED SYLLABUS**

**UNIT – I Condition Based Maintenance (09 Periods)**

Introduction, Maintenance Strategies, Condition Monitoring Methods- Vibration Analysis- Oil Analysis- Performance Analysis- Thermography; Types and Benefits of Vibration Analysis; Vibration Transducers- Absolute vs Relative Vibration Measurement -Proximity Probes -Velocity Transducers – Accelerometers -Dual Vibration Probes -Laser Vibrometers; Torsional Vibration Transducers- Shaft encoders- Torsional Laser Vibrometers; Condition Monitoring - Basic Problems.

**UNIT-II Signal Processing Techniques (09 Periods)**

Basic concept, techniques - visual monitoring, temperature monitoring, vibration monitoring,lubricant monitoring, crack monitoring, thickness monitoring, noise and sound monitoring.Probability distribution and density, Fourier analysis, Hilbert Transform, Cepstrumanalysis,Digital filtering, Deterministic / random signal separation, Time-frequency analysis.

**UNIT – III Fault Detection (09 Periods)**

Introduction, Rotating Machines - Vibration Criteria- Use of Frequency Spectra- CPB Spectrum Comparison; Reciprocating Machines- Vibration Criteria for Reciprocating Machines- Time–Frequency Diagrams- Torsional Vibration; Fault Trending and Prognostics- Trend Analysis- Trending of Simple Parameters- Trending of Impulsiveness; Determination of Spall Size in Bearings; Advanced Prognostics- Data-Driven Models- Hybrid Models.

**UNIT – IV Diagnostic Techniques (09 Periods)**

Harmonic and Sideband Cursors; Minimum Entropy Deconvolution; Gear Diagnostics- Techniques Based on the TSA- Transmission Error as a Diagnostic Tool- Separation of Spalls and Cracks- Diagnostics of Gears with Varying Speed and Load; Rolling Element Bearing Diagnostics- Signal Models for Bearing Faults- A Semi-automated Bearing Diagnostic Procedure; Reciprocating Machine and IC Engine Diagnostics- Time–Frequency Methods- Cylinder Pressure Identification.

**UNIT – V Vibration Monitoring (09 Periods)**

Vibration Monitoring Introduction, vibration data collection, techniques, instruments, measurement location, time domain analysis, frequency domain analysis, time-frequency domain analysis and commonly witnessed machinery faults diagnosed by vibration analysis. Vibration signals from rotating and reciprocating machines – signal classification, signals generated by rotating machines, signals generated by reciprocating machines.

**Total Periods: 45**

**TEXT BOOKS:**


1. Robert Bond Randall – Vibration-Based Condition Monitoring – Industrial, Aerospace and Automotive applications, John Wiley & Sons Ltd., 2011 DOI:10.1002/9780470977668
2. R.A.Collacot – Mechanical Fault Diagnosis – Chapman and Hall Ltd., 1977.
3. NOC: Machinery Fault Diagnosis and Signal Processing Prof. Amiya Ranjan Mohanty Mechanical Engineering IIT Kharagpur.
4. R.C.Mishra, K.Pathak – Maintenance Engineering and Management, Prentice Hall ofIndia Pvt. Ltd., 2002.


**REFERENCES MATERIALS / BOOKS:**


1. Dr. K.Balaveera Reddy, ISTE Summer School on Machinery Diagnostics and Preventive Maintenance, KREC, Surathkal, June 19-25, 1995.
2. Dr. A.Ramachandra, ISTE-STTP on Maintenance of Machinery, SJCE, Mysore, June 18-31, 2000.
3. John S.Mitchell, Introduction to Machinery Analysis and Monitoring, PennWell Books, 1993.

## III B. Tech. – II Semester

## (19BT61531)**Internet of Things LAB**

(Common to CE, ME, CSE, CSSE & IT)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 50 | 50 | 100 | - | 1 | 2 | 2 |

**PRE-REQUISITES:-**

**COURSE DESCRIPTION:**

Setting up **IoT** work-flow, Programming with Python, Micro-controller programming using Arduino, Building **IoT** Applications using Raspberry Pi, **IoT** Cloud Infrastructure.

**COURSEEDUCATIONAL OBJECTIVES:**

**CEO1.** To impart knowledge on fundamentals of IoT.
**CEO2.** To imbibe skills to design applications to push sensor data to cloud.
**CEO3.** To inculcate attitude to develop real time applications in IoT.

**COURSE OUTCOMES:**

*After successful completion of this course, the students will be able to:*

**CO1**. Design an interface to embedded systems using real time sensors with Arduino and Raspberry Pi.

**CO2.** Develop applications to capture the data generated by sensors and send to cloud.

**CO3**. Develop real time applications using NodeMCU and BLYNK.

**CO4**. Design applications to push sensor data to cloud using MQTT protocol.

**CO5**.Work independently and in team to solve problems with effective communication.

**Theory Component:** **(10 Periods)**

system with camera, PIR sensor, light sensor, motion detector, NodeMCU, BLYNK, cloud

**LIST OF EXPERIMENTS:**

Arduino IDE, 7-segment display, Servo motor, ultrasonic sensor, LCD, Flame sensor, gas sensor, Humidity & temperature sensors, MQTT protocols, ECG System, Raspberry Pi, Home security

1. (a) Design and Simulate LED 7-Segment Display interfacing with Arduino.
   (b) Design and Simulate Servo motor interfacing with Arduino.
2. (a) Design and Simulate ultrasonic sensor and LCD interfacing with Arduino.
   (b) Design and Simulate Flame Sensor interfacing with Arduino.
3. Design and Implement to capture Gas Sensor and send sensor data to cloud from your NodeMCU device using Arduino IDE.
4. Design and Implementation of Humidity and Temperature Monitoring Using Arduino and upload data to cloud using MQTT.
5. Design and Implementation of an IoT ECG (Electrocardiogram) System to record hearts electrical activity.
6. Design and Simulate controlling an LED 7-Segment Display with Raspberry Pi.
7. Design and implementation of Raspberry Pi Home Security System with Camera and PIR Sensor with Email Notifications.
8. Design and Implement to upload Light sensor (TSL) data to cloud through Raspberry Pi.
9. Design and Implementation of Motion Detector with NodeMCU and BLYNK.
10. Design and Implementation of Fire notification IoT system with BLYNK.

**REFERENCE BOOKS:**


1. Adrian McEwen and HakinCassimally, *Designing the Internet of Things,* Wiley India.
2. Simon Monk, *Programming Aurdino,* Second Edition,McGraw-Hill Education**,**2016.
3. Matt Richardson and Shawn Wallace, *Getting Started with Raspberry Pi*, O'Reilly, 2014.
4. Rahul Dubey, *An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications* , Cengage Learning India Pvt. Ltd,2019

**IV B. Tech. I Semester**

**(19BT70302) OPERATIONS MANAGEMENT**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITE: Operations Research**

**COURSE DESCRIPTION:**

Introduction to Operations Management, Services as a part of operations management; Regression and correlation methods; Material Requirements Planning Logic; Capacity Requirements Planning; Scheduling of Job Shops; Operational Control issues in Mass Production systems; Continuous improvement Process.

**COURSE OBJECTIVES:**

**CEO1.** To impart the knowledge on Operation Strategy, Demand Forecasting,Aggregate Planning, Operation Scheduling and Lean Management

**CEO2.** To develop skills in solving problems related to Operations Management.

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to:

CO1 Apply operations strategy through strategic means, measures and decisions for attaining operational excellence.

CO2 Model demand forecasting problems and develop accurate forecasts.

CO3 Apply aggregate production planning techniques to order optimal material quantities.

CO4 Apply operation scheduling and control issues for smooth production.

CO5 Demonstrate lean management strategies for creating a stable workflow based on actual customer demand.

**DETAILED SYLLABUS:**

**UNIT- I: OPERATIONS STRATEGY (08 periods)**

Introduction to Operations Management, Services as a part of operations management, Relevance of Operations Strategy, Strategy formulation process, Measures of operational excellence, Options for strategic decisions in operations, World-class manufacturing practices, Emerging trends and implications for operations

**UNIT- II: DEMAND FORECASTING (09 periods)**

Forecasting techniques- causal and time series models, moving average, exponential smoothing, trend and seasonality; Regression and correlation methods; Accuracy of forecasts, Application and control of forecasts.

**UNIT- III: AGGREGATE PRODUCTION PLANNING (10 periods)**

Need for Aggregate Production Planning, Alternatives for managing demand and supply, Strategies for Aggregate Production Planning, Master Production Scheduling, Material Requirements Planning Logic, Capacity Requirements Planning, Distribution Requirements Planning, Enterprise Resource Planning and Supply Chain Management.

**UNIT- IV: OPERATIONS SCHEDULING (09 periods)**

Need for Scheduling, Scheduling rules and performance criteria, Scheduling of Flow Shops – Johnson's rule; Scheduling of Job Shops, Operational Control issues in Mass Productionsystems,Operations Planning and Control based on Theory of Constraints.

**UNIT- V: LEAN MANAGEMENT** **(09 periods)**

Philosophy of Lean Management, Elements of JIT Manufacturing, Production Planning and Control in JIT, Continuous improvement Process, Organizational challenges in Lean Management, Six-Sigma approach to Quality Control, Six-Sigma Methodology, and Lean Six-Sigma

**Total Periods: 45**

**TEXT BOOKS:**


3. B.Mahadevan, Operations Management, Pearson education, 3rd edition, 2014.
4. Lee J Krajewski, M K Malhotraand Larry P Ritzman, Operations management – Processes and Supply Chains, 12th edition, 2019.


**REFERENCE BOOKS:**


4. Monks J.G., Operations Management, Schaums outline series, McGrawHill, 2nd edition, 2020.
5. R Pannerselvam, Production and Operations Management, PHI learning, 3rd edition, 2012.

## IV B. Tech - I Semester
## (16BT70311)PRODUCTION AND OPERATIONS MANAGEMENT

(Program Elective-3)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | -- | 3 |

**PRE-REQUISITES:**

Course on Industrial Engineering and Management.

**COURSE DESCRIPTION:**

Overview of production and operations management concepts and issues from both strategic and operational perspective; relationships between operations and environment; analysis of strategic issues relating to competitiveness in production and operations management, and application of tools to improve productivity in production and operations; concepts/principles related to management of operations – forecasting demand; production, material and capacity requirements planning; scheduling; inventory planning and control; lean and supply chain management systems.

**COURSE OUTCOMES:**

On successful completion of this course, students will be able to:

CO1. Demonstrate the knowledge of Aggregate Planning, Scheduling, Forecasting, and Supply Chain Management to various operations of industry.
CO2. Analyze the operations of an industry and incorporate principles and concepts of operations management to asses and improve operational performance.
CO3. Design a process by optimizing the use of resources that meet the specified needs with appropriate consideration for industrial operations.
CO4. Apply the techniques of forecasting, aggregate planning, Just-In-Time, Enterprise Resource Planning, Kaizen to establish methods for maximizing productivity.
CO5. Use the concepts of operations management and specialized knowledge in Operations Management to solve business processes steering to meet societal needs.
CO6. Manage the industrial projects from forecasting of demand, identification of Material requirements, scheduling on machines and dispatching it to customer

**DETAILED SYLLABUS:**

**UNIT - I: OPERATIONS MANAGEMENT CONCEPTS (09 Periods)**

Introduction, Historical development, Information and Nonmanufacturing systems, Operations management, Factors affecting productivity, International dimensions of productivity, environment of operations, Production systems decisions.

**UNIT - II: FORECASTING DEMAND (09 Periods)**

Forecasting: objectives and uses, Forecasting variables, Opinion and judgmental methods, Time Series Methods: Moving Average Method, Weighted Moving Average Method, Exponential smoothing, Regression and correlation methods; Application and control of forecasts.

**UNIT - III: AGGREGATE PRODUCTION PLANNING (09 Periods)**

Planning hierarchies in operations, Need for aggregate production Planning, Alternatives for managing supply and demand, Basic strategies for aggregate production planning - level, Chase and mixed, Aggregate Production Planning Methods, Master production scheduling. Introduction to aggregate capacity planning.

**UNIT - IV: MATERIAL REQUIREMENTS PLANNING & LEAN SYSTEMS (09 Periods)**

MRP-underlying concepts, Bill of Material, System parameters, MRP logic, System refinements. Manufacturing Resource Planning, Enterprise Resource Planning. Just-in-Time, Pull method of materials flow, Consistently high quality, Small lot sizes, Uniform

workstation loads, Standardized components and work methods, Close supplier ties, Flexible workforce, Line flows, Automated production, Preventive maintenance, continuous improvement, Kaizen.

**UNIT - V: MACHINE SCHEDULING & SUPPLY CHAIN MANAGEMENT**

**(09 Periods)**

Flow shop scheduling- Introduction, Johnson's rule for 'n' jobs on 2 and 3 machines, CDS heuristic, Palmer's Heuristic; Job scheduling- Types of schedules, Heuristic procedure, scheduling 2 jobs on 'm' machines, Supply chain components, Supply chain structures, Bullwhip effect, Role of information technology in Supply Chain Management.

**Total Periods: 45**

**TEXT BOOKS:**


1. B.Mahadevan, *Operations Management*, Pearson education, 2nd edition, 2010.
2. Everett E. Adams and Ronald J. Ebert, *Production and Operations Management*, PHI Learning, 5th edition, 2009.
3. Lee J Krajewski, Larry P Ritzman and M K Malhotra, *Operations Management – Processes and Value Chains*, 8th edition, 2008.


**REFERENCE BOOKS:**


1. S N Chary, *Production and Operations Management*, Tata-McGraw-Hill education (India), Pvt limited, 2013.
2. Monks J.G., *Operations Management*, Schaums outline series, McGraw-Hill International Edition, 5th edition, 1996.
3. R Pannerselvam, *Production and Operations Management*, PHI learning, 2nd edition, 2009.

**IV B. Tech. – I Semester**

**(19BT70305)MATERIAL PROCESSING TECHNIQUES**

**(Professional Elective-4)**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES: Courses on** Materials Science and engineering , Manufacturing Technology**,** Metal Cutting and Machine Tools.

**COURSE DESCRIPTION:**

Metal forming and its types; Micromachining and its measuring techniques;fundamentals of laser and its applications; advanced welding processes and testing; advanced finishing processes.

**COURSE OBJECTIVES:**

**CEO1:** To impart knowledge on metal forming process, significant process parameters and diverse applications.

**CEO2:** To develop skill in analyze the of welding process, its testing methods, machining process,measuring procedures and various laser-processing techniques. .

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

**CO1:** Demonstrate the knowledge on advances in metal forming processes, process parameters and their techniques.

**CO2:** Demonstrate the knowledge on micro-machining process and its measuring techniques.

**CO3:** Analyze the functional characteristics of laser processing for diverse applications.

**CO4:** Demonstrate the knowledge onadvanced welding process and tests to enhance the quality of welds

**CO5:** Apply appropriate finishing techniques and explore the mechanisms involved.

**DETAILED SYLLABUS:**

**UNIT - I ADVANCES IN METAL FORMING (9 periods)**

Conventional processes-High Energy Rate Forming techniques-Explosive forming, Electro hydraulic forming, Magnetic pulse forming, Super plastic forming, Rubber forming, Flow forming - Principles and process parameters- Advantages -Limitations and Applications. Overviews of powder metal forming technique-Advantages- Applications-Powder perform forging- Hot and cold Isostatic pressing- Powder rolling-Tooling and process parameters.

**UNIT II -MICRO-MACHINING (9 periods)**

Introduction to micromachining technologies, Microelectro discharge Machining: Principles of micro-EDM, Micro-EDM by Die-sinking and WEDG, Micro-WEDM, Micro-WEDG, Micro-ECM, Principles of micro-turning, Micro-drilling and Micro-milling, Micro grinding, Hybrid micro-machining method, On-line measurement by machine vision and integratedprobe, Measuring Techniques in micro-machining, Surface integrity and other related measurements.

**UNIT III-LASER MATERIALS PROCESSING (9 periods)**

Fundamentals of industrial lasers - Laser materials interaction theories - Laser processing for various industries such as metals, non-metals, photovoltaic, bio-medical applications. Laser optics- Heat flow theory, Pulsed lasers, Pulsed laser heating, Laser cutting, Laser welding, Laser surface modifications. Diffusion Modelling, Laser cladding, Laser texturing, Laser bending, Laser safety and Laser micromachining.

**UNIT IV –ADVANCED FABRICATION PROCESSES (9 periods)**

Introduction, Advancements in Fabrication Techniques -Thermit welding, Electro slag welding, Electron beam welding, laser beamwelding, forge welding, friction welding, diffusion welding, explosionwelding, ultrasonic metal welding, destructive & non-destructive testingof welds.

**UNIT V-ADVANCED FINE FINISHING PROCESS (9 periods)**

Abrasive Flow Machining; Magnetic Abrasive Finishing; Magneto Rheological Abrasive Finishing: Principle, Process equipment; Analysis and modelling of finishing mechanism; Parametric analysis; Applications.

**Total Periods: *45***

**TEXT BOOKS:**


1. M P Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, John Wiley & Sons,3rdEdition, India, 2007.
2. Pandey, P.C., and Shan, H.S., "Modern Machining Processes", Tata McGraw-Hill Education, New Edition, UK, 2017.


**REFERENCE BOOKS:**


1. SeropeKalpakjian, "Manufacturing Processes for Engineering Materials", Pearson Education, 5th Edition, UK, 2017.
2. PeterSchaaf, "Laser Processing of Materials: Fundamentals, Applications and Developments", Springer Publishers, 1st Edition, USA, 2010.


**ADDITIONAL LEARNING RESOURCES:**

1. NPTEL Course
2. MOOC Course
3. Workshop/Seminar/Guest Lecture/Expert Lecture
4. Conferences
5. Summer Internships at Reputed Institutions

**IV B. Tech. – I Semester**

(19BT70308)**Sustainable Manufacturing**

(Professional Elective-4)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**--

**COURSE DESCRIPTION:**

Concept of sustainability; metrics of green manufacturing; economic and social dimensions of sustainability; Principles of green manufacturing; Principles of green manufacturing; Green supply chain

**COURSE OBJECTIVES:**

CEO1: To impart knowledge on Sustainable manufacturing techniques for designing eco-friendly and environment conscious products

CEO2: To develop skills in performing carbon footprint analysis and Life Cycle Assessment (LCA) specific to manufacturing systems and processes

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1 Demonstrate the knowledge of sustainable manufacturing tools and techniques for sustainable product development

CO2 Applysustainabilityassessmenttools and techniques to infuse and manage the sustainability of a product.

CO3 Analyze the environmental impact of a product through its life cycle encompassing extraction and processing of the raw materials, manufacturing, distribution, use, recycling, and final disposal.

CO4 Demonstrate the knowledge on green manufacturing techniques for renewal of production processes and the establishment of environmentally-friendly operations within the manufacturing field

CO5 Demonstrate the knowledge on sustainability assessment and green supply chain in infusing sustainability.

.

**DETAILED SYLLABUS:**

**UNIT I– INTRODUCTION TO SUSTAINABLE MANUFACTURING (9 periods)**

Concept of sustainability, manufacturing, operations, processes, practices, Resources in manufacturing, five Ms, system approach to manufacturing, environmental, economic and social dimensions of sustainability, Environmental Impact of Manufacturing, Strategies for Green Manufacturing, Metrics for Green Manufacturing, Metrics Development Methodologies.

**UNIT II–TOOLS AND TECHNIQUES (9 periods)**

Principles of green manufacturing and its efficiency, Green manufacturing and sustainability, System model architecture and module, Design and planning, control or tools for green manufacturing (Qualitative Analysis), Consumption Analysis, Life Cycle Analysis, Efficiency, Sustainability tools). Standards for green manufacturing (ISO 14000 and OHSAS 18000), Waste stream mapping and application, Design for environment and for sustainability – Discuss the Product Life Cycle of manufactured goods.

**UNIT III – LIFE CYCLE ANALYSIS (9 periods)**

Remanufacture and disposal , tools for LCA, Concept of design for recycling, Green manufacturing Lean models, value analysis, carbon footprint, analysis for carbon footprint Green manufacturing- sustainability framework, Green manufacturing techniques- factors effecting sustainability.

**UNIT IV – GREEN MANUFACTURING TECHNIQUES (9 periods)**

Dry and near-dry machining, edible oil based cutting fluids Green manufacturing techniques: cryogenic machining for eco-efficiency Green manufacturing, Lean manufacturing, Lean techniques for green manufacturing, Waste assessment and strategies for waste reduction in green manufacturing.

**UNIT V – SUSTAINABILITY ASSESMENT AND GREEN SUPPLY CHAIN (9 periods)**

Methods to infuse sustainability in early product design phases, concept models and various approaches in assessment, product sustainability and risk/benefit assessment, Green supply chain- techniques and implementation, Logistics management, Green Supply Chain as Product Life Cycle Management

**Total Periods: *45***

**TEXT BOOKS:**


1. G.Atkinson,S.Dietz,E.Neumayer,*HandbookofSustainableManufacturing*‖.Edward Elgar Publishing Limited,2007.
2. Klemes, J., 2011. Sustainability in the process industry. McGraw-Hill.2011
3. M.Karpagam, Geetha Jaikumar, *Green Management* ,Ane Books Pvt.Ltd.2010


**REFERENCE BOOKS:**


1. M.K. Ghosh Roy, *Design for Environment: A guide to sustainable Product Development Sustainable Development*, Ane Books Pvt.Ltd,2009.
2. Dornfeld, D.A. ed., *Green manufacturing: fundamentals and applications*. Springer Science & Business Media,2012.
3. Ashby, M. F. *Materials and the environment: eco-informed material choice*. Elsevier, 2012.
4. D. Rodick, Industrial Development for the 21st century, sustainable development perspectives, UN New York, 2007

**IV B. Tech – I Semester**

19BT70309: **CRYOGENICS**

(Program Elective-5)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 0 | -- | 3 |

**PRE-REQUISITES:**

A Course on Refrigeration & Air-conditioning

**COURSE DESCRIPTION:**

Necessity of Low temperature, Multi stage refrigeration, Cascade system, Applications of low temperature, Properties of cryogenic fluids, Liquefaction of air, hydrogen and helium, gas separation and gas purification systems,Low temperature insulation, Storage systems and Cryogenic fluid transfer systems

**COURSE OBJECTIVES:**

CEO1. To impart the knowledge of low temperature refrigeration.
CEO2. To develop the analyzing skills in the low temperature refrigeration applications.

**COURSE OUTCOMES:**

On successful completion of this course, the students will be able to:

CO1: Demonstrate the knowledge of cryogenic systems for low temperature applications.

CO2: Analyze the properties of cryogenic fluids for low temperature application.

CO3: Analyze the various refrigeration and liquefaction systems for low temperature application.

CO4: Analyze the various gas separation and gas purification systems for low temperature application.

CO5: Demonstrate the knowledge of cryogenic insulation for suitable storage and handling systems.

**DETAILED SYLLABUS**

**UNIT- I: CRYOGENIC SYSTEMS (09 periods)**

Introduction to Cryogenic Systems, Cryogenics – Definition, Historical development, Necessity of Low temperature, Limitations of vapour compression system for the production of low temperature, Multi stage refrigeration system - Cascade system.

Applications of Cryogenics: Applications in space, Food Processing, super conductivity, Electrical Power, Cryobiology, Medicine-Cryosurgery, Electronics and Cutting Tool Industry.

**UNIT- II: PROPERTIES OF CRYOGENIC FLUIDS (09 periods)**

Effects on the properties of metals - Low Temperature properties of Engineering Materials- Mechanical properties, Thermal properties, Super conductivity and Super fluidity, Electric and magnetic properties

T-S diagram of a cryogen; Properties of cryogenic fluids - Liquid Methane, Liquid Neon, Liquid Nitrogen, Liquid Oxygen, Liquid Argon, Liquid Air, Liquid hydrogen and helium.

**UNIT- III: REFRIGERATION AND LIQUEFICATION (09 periods)**

Manufacture of Dry ice, Joule's Thomson effect, Liquefication of air - Linde system, Claude system, Cascaded System, Liquefaction of neon, Hydrogen and Helium, Stirling Cycle Cryo Coolers, Gifford Mcmahon Cryo- refrigerator, Pulse tube refrigerator, Solvay cycle refrigerator, Vuillimier refrigerator.

**UNIT – IV GAS SEPARATION AND GAS PURIFICATION SYSTEMS (09 periods)**

The thermodynamically ideal separation system properties of mixtures, Principles of gas separation, air separation systems, Hydrogen, Argon, Helium air separation systems, Gas purification methods.

**UNIT- V: LOW TEMPERATURE INSULATION (09 periods)**

Types of Insulation - Reflective insulation, Evacuated powders, Rigid foams; Super insulation; Dewar vessels; Hazards in cryogenic engineering. Cryogenic fluid transfer systems. Transfer through un-insulated lines, vacuum insulated lines, porous insulated lines etc.

**TEXT BOOKS:**


1. Randal F.Barron, Cryogenic systems, McGraw Hill, 2nd edition, 1986
2. Klaus D.Timmerhaus and Thomas M.Flynn, Cryogenic Process Engineering, Plenum Press, New York, 1989.


**REFERENCE BOOKS:**


1. Traugott H.K. Frederking and S.W.K. Yuan, Cryogenics - Low Temperature Engineering and Applied Sciences, Yutopian Enterprises, 2005.
2. A. R. Jha, Cryogenic Technology and Applications, Butterworth-Heinemann, 2005

## IV B. Tech – I Semester
## (16BT70304)CRYOGENICS

(Program Elective-2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | -- | 3 |

**PRE-REQUISITES:** Course on Refrigeration & Air-conditioning

**COURSE DESCRIPTION:** Necessity of Low temperature, Multi stage refrigeration, Cascade system, Properties of cryogenic fluids, Liquefication of air, hydrogen and helium, Applications of low temperature, Low temperature insulation, Storage systems.

**COURSE OUTCOMES:** On successful completion of this course, students will be able to:

CO1. Demonstrate the principles of cryogenics in various low temperature refrigeration applications.

CO2. Analyze the various refrigeration cycles in solving cryogenic problems.

CO3. Present the probable solution in the design of insulation to the various systems in handling the cryogenic fluids.

CO4. Conduct investigations cryogenic fluids suitable for low temperature applications in real time situations.

CO5. Apply the suitable storage and handling systems for various cryogenic fluids.

**DETAILED SYLLABUS:**

**UNIT - I: INTRODUCTION (09 Periods)**

Necessity of Low temperature, Limitations of vapour compression system for the production of low temperature, Multi stage refrigeration system - Cascade system.

**UNIT - II: PROPERTIES OF CRYOGENIC FLUIDS (08 Periods)**

Cryogenics - Definition, T-S diagram of a cryogen; Properties of cryogenic fluids - Liquid Methane, Liquid Neon, Liquid Nitrogen, Liquid Oxygen, Liquid Argon, Liquid Air.

**UNIT - III: REFRIGERATION AND LIQUEFICATION (09 Periods)**

Manufacture of Dry ice, Joule's Thomson effect, Liquefication of air - Linde system, Claude system, Liquefication of Hydrogen and Helium.

**UNIT - IV: APPLICATIONS OF LOW TEMPERATURE (09 Periods)**

Effects on the properties of metals - Strength, Thermal properties, Super conductivity and Super fluidity; Applications of low temperature - Expansion fitting, Cryobiology, Cryosurgery, Space research, Computers and Underground power lines.

**UNIT - V: LOW TEMPERATURE INSULATION (10 Periods)**

Types of Insulation - Reflective insulation, Evacuated powders, Rigid foams; Super insulation; Dewar vessels; Hazards in cryogenic engineering.

**Total Periods: 45**

**TEXT BOOKS:**


1. Domkundwar Arora Domkundwar, *A course in Refrigeration and Air-conditioning*, Dhanpat Rai Co., 7th Edition, 2002.
2. P L Ballany, *Refrigeration and Air-conditioning*, Khanna Publishers, 15th Edition 2009.

**REFERENCE BOOKS:**


1. Traugott H.K. Frederking and S.W.K. Yuan, *Cryogenics - Low Temperature Engineering and Applied Sciences*, Yutopian Enterprises, 2005.
2. A. R. Jha, *Cryogenic Technology and Applications*, Butterworth-Heinemann, 2005

**IV B. Tech. – I Semester**

**(19BT70310) Design of Automotive components**

(Professional Elective – 5)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:** Course on Strength of Materials and Design of Machine Elements.

**COURSEDESCRIPTION:** Design of cylinder, piston,connecting rod, crank shaft, Center and over hung cranks;Clutch applications in automobile, Working of Fluid Coupling; Propeller Shaft; Differential and Axles; Types of lubrication, Performance parameters of bearings; Classification of brakes; Hydraulic, Pneumatic Brakes and Power Brakes, Anti-Lock Brake system; Performance of gear box in vehicles, traction and tractive effort calculations; design of three and four speed gear box; Types of Front Axle;

**COURSE OBJECTIVES:**

CEO1: To impart the knowledge on the I.C Engine parts, clutches, Propeller Shaft, gear boxes, Lubricants, bearings and brakes.

CEO2: To develop skills in Axles, Gear box and Steering system applications in the design of Automotive components.

**COURSEOUTCOMES:** On successful completion of this course, students will be able to:

CO1: DesignCylinder, Piston, connecting rod, crank shaft andCenter and over hung cranks for automobile vehicles considering safety standards.

CO2: Design Power drive lines and calculate performance parameters.

CO3: DesignBearings and Brakessystems for automobile vehicles considering safety standards.

CO4: Designgearboxfor automobile vehicles and calculate its performance characteristics.

CO5: Design front axle and steering linkages and determine optimum dimensions and proportions for steering linkages ensuring minimum error in steering

## DETAILED SYLLABUS:

**UNIT - I: DESIGN OF IC ENGINE PARTS: (9 Periods)**

Introduction to I.C engine parts, design of cylinder, design of piston, piston rings, piston pin; Connecting rod, Working Principle and Essential loads on the connecting rod; Crank shaft, Working Principle and design of Crankshaft, determination of loads atCenter and over hung cranks.

**UNIT-II: POWER DRIVE LINE: (9 Periods)**

Introduction to Clutch - Types and Construction, Fluid Coupling, Transmissions,design details of roller and sprag type of clutches - Manual, Semi and Automotive Transmission, Continuously Variable Transmission, Overdrives, Torque Converter, Propeller Shaft, Differential and Axles, Front and All Wheel Drive Vehicles.

**UNIT - III:DESIGN OF BEARINGS AND BRAKING SYSTEMS : (9 Periods)**

Introduction to Lubrication, Viscosity, Classification;Introduction to Bearings , Hydrodynamic & Hydrostatic Lubrication, Pressure distribution - eccentricity and minimum film thickness, Thick & Thin film lubrication, Bearing materials, choice of bearings,determination of loads at kingpin bearings, wheel spindle bearings.

Braking Systems - Hydraulic, Pneumatic Brakes and Power Brakes; Anti-Lock Brake system.

**UNIT-IV: DESIGN OF GEAR BOX: (8 Periods)**

Introduction to gear box, Performance of vehicle, total resistance to motion, Forces and Couples, traction and tractive effort, acceleration, calculation of gear ratio, design of three speed gear box, design of four speed gear boxes.

**UNIT - V: DESIGN OF FRONT AXLE AND STEERING: (10 Periods)**

Types of Front Axle, Analysis of loads, moments and stresses at different sections of front axle; Differential and Axles, Front and All Wheel Drive Vehicles. Steering Geometry and Types, Steering Linkages, Power Assisted Steering; Determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.

**TEXT BOOKS:**

T1. Bhandari V, Design of Machine Elements, 5th Edition, Tata McGraw-Hill Book Co, 2020.

T2. Harald Naunheimer , Bernd Bertsche , Joachim Ryborz , Wolfgang Novak "Automotive Transmission: Fundamentals, Selection, Design and Application", 2nd Edition, Springer, 2011.

**REFERENCE BOOKS:**

*R1.* Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 11th Edition, Tata McGraw-Hill, 2020.

R2. Judge A. W., "Modern Transmission", 3rd ed., Chapman & Hall Std., London, 1989.

R3. CDX Automotive, "Fundamentals of Automotive Technology, Principles and practice", Jones &Barlett Publishers, 2013.

R4. Newton Steeds & Garrot, "Motor Vehicles", SAE International and Butterworth Heinemann, 2001.

R5. Mahadevan, k, Reddy, K. Balaveera, "Design Data Handbook for Mechanical Engineering in SI and Metric Units", CBS; 4th edition,2019.

**Data Book:** Design data hand book for Mechanical Engineers in SI and Metric units by Balaveera Reddy and Mahadevan.N

**IV B. Tech. – I Semester**

(19BT70313)**Surface Engineering**

(Professional Elective-5)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

Materials Science, Strength of Materials, Metrology and Measurements

**COURSE DESCRIPTION:**

Mechanisms of wear; Metal cleaning; Techniques for surface modification or deposition of protective coatings; Rationale behind employing coatings; Quality assurance & testing.

**COURSE OBJECTIVES:**

CEO1: To impart knowledge of surface coatings, process,characterization.
CEO2: To develop skill in the performance assessment tools of surface coatings

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Demonstrate the knowledge of surface engineering processes.
CO2: Analyze functional and operational characteristics of thermal spraying and electro deposited coatings for different applications.
CO3: Analyze functional and operational characteristics of hot dip and diffusion coatings for engineering applications.
CO4: Analyze functional and operational characteristics ofnon-metallic and conversion coatings for different surfaces.
CO5: Apply testing procedures for qualitative assessment of different coating.

**DETAILED SYLLABUS:**

**UNIT I– INTRODUCTION TO SURFACE ENGINEERING (10 periods)**

Importance and necessity of surface engineering, past, present and future scenario of surface engineering , classification of surface engineering process, substrates and their pretreatments; coating characteristics: coating thickness, continuity, hardness, adhesion, porosity, and bond strength,General cleaning process for ferrous and non-ferrous metals, selection of cleaning process, alkaline cleaning, emulsion cleaning, ultrasonic cleaning and abrasive bath cleaning.

**UNIT II–THERMAL SPRAYING AND ELECTRODEPOSITED COATINGS (9 periods)**

Thermal spraying materials, characteristics of thermal spray process, Spray fused coatings, principles of electro plating, properties and applications of electrodeposits, Principles of Non aqueous and electro less deposition, Plasma spraying, flame spraying, detonation spray coating.

**UNIT III – HOT DIP COATING AND DIFFUSION COATING (9 periods)**

Surface preparation, Batch coating and continuous coating process, coating properties and applications, principles of cementation, cladding-vacuum deposition, sprayed metal coating, structure of diffusion coatings, Chemical vapour deposition (CVD), Physical vapour deposition (PVD),Thin film Characterization techniques- Scanning Electron Microscopy and Energy dispersive X-ray analysis

**UNIT IV – NON-METALLIC COATING OXIDE AND CONVERSION COATINGS**

**(9 periods)**

Plating coating, lacquers, rubbers and elastomers, vitreous enamels, anodizing Chromating, application to aluminum, magnesium, tin, zinc, cadmium, copper and silver, Phosphating primers.

**UNIT V – TESTING AND SELECTION OF COATINGS (8 periods)**

Quality assurance, the quality plan, design testing and inspection, thickness and porosity measurement, selection of coatings, Industrial applications of engineering coatings, Performance assessment of engineered surfaces- wear and corrosion.

**Total Periods: *45***

**TEXT BOOKS:**

1. Engineering Coatings-design and application-S. Grainger, Jaico Publishing House.
2. Principles of Metals surface treatment and protection- D.R. Gabe, Pergamon.
3. Surface Engineering for wear resistance- K.G Budinski, Prentice Hall.

**REFERENCE BOOKS:**

1. Electroplating Handbooks- N.V Parthasarathy, Prentice Hall.
2. Advances in surface treatment- Niku-Lavi, Pergamon.

**IV B. Tech – I Semester**

**(19BT70314) HYBRID AND ELECTRIC VEHICLE**

(Professional Elective – 5)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Automobile Engineering.

**COURSE DESCRIPTION:** History of hybrid and electric vehicles; Drive trains; Configuration and control of electric components; Types of energy storage devices;Sizing the drive systems; Energy management strategies in hybrid and electric vehicles.

**COURSE OBJECTIVES:**

CEO1: To impart the knowledge on principles and applications various electric components of hybrid and electric vehicle.

CEO2: To develop skills in design and analysis of various energy storage devices suitable for a hybrid and electric vehicle.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Analyze the performance characteristics of transmission systems in hybrid and electric vehicle(HEVs).

CO2: Demonstrate the knowledge of electric propulsion incorporated in HEVs.

CO3: Analyze the dimensional features drive systems for optimal matching of electric machine and the internal combustion engine.

CO4: Analyze and select the energy storage devices of hybrid and electric vehicle for the given applications.

CO5: Demonstrate the knowledge of theenergy management strategiesand implementation issues in hybrid and electric vehicles.

**DETAILED SYLLABUS:**

**UNIT I– INTRODUCTION TO TRANSMISSION SYSTEMS (9 periods)**

**INTRODUCTION:** History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Comparison of transmission systems, Impact of modern drive trains on energy supplies.

**DRIVE TRAINS FOR HYBRID AND ELECTRIC VEHICLES:** Basic concept of traction, Types of drive – train topologies, power flow control, fuel efficiency analysis.

**UNIT II –ELECTRIC PROPULSION UNIT (9 periods)**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control - DC motor drives, induction motor drives, permanent magnet motor drives, switch reluctance motor drives, drive system efficiency.

**UNIT III –SIZING THE DRIVE SYSTEM (9 periods)**

Matching the electric machine and the internal combustion engine, Sizing the propulsion motor, Sizing the power electronics, Selecting the energy storage technology, Supporting sub systems.

**UNIT IV –ENERGY STORAGE (9 periods)**

Introduction to energy storage, Requirements in hybrid and electric vehicles, Types of energy storage and its analysis - Battery based, Fuel cell based, Super capacitor based, Fly wheel based, Hybridization of different energy storage devices.

**UNIT V –Energy Management Strategies (9 periods)**

Introduction to Energy Management Strategies used in hybrid and electric vehicles, Classification of different Energy Management Strategies, Comparison of different Energy Management Strategies, Implementation issues of Energy Management Strategies.

**Total Periods: *45***

**TEXT BOOKS:**


3. IqbalHussain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
4. MehrdadEhsani, YimiGao, Sebastain E, Gay, Ali Emadi, Modern Hybrid Electric and Fuel cell Vehicles: Fundamentals Theory and Design, CRC Press, 2004.


**REFERENCE BOOKS:**


1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. Tom Denton, Electric and Hybrid Vehicles, Routledge, 2016.

**IV B. Tech. – I Semester**

**(19BT70331)INDUSTRIALAUTOMATION AND ROBOTICS LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 50 | 50 | 100 | - | - | 2 | 1 |

**PRE-REQUISITES:**

*Industrial Robotics*

**COURSE DESCRIPTION:**

This laboratory is intended to provide hands-on experience on industrial robotics, manufacturing automation, mobile robotics, and dynamics and control of field robots. The students experiment with various automation systems, learn to program, implement planning and control algorithms.

**COURSE OBJECTIVES:**

CEO1: To impart knowledge on various configurations of robot.

CEO2: To develop skills in the robot programming and robot modeling in the robot design software.

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1: Apply different motion commands of various configurations of robot and perform different tasks relative toits degrees of freedom using programming.

CO2: Design various combinations of gripper design with the robot configuration suitable for industrial applications.

CO3: Develop virtual robot in the Robot simulation software , which will perform all the functions of a 3R Manipulator in real-time.

Co4: Demonstrate the knowledge ofautomationprocess , robotic end effectors and robotic arm configurations.

CO5: Work independently or in teams to solve problems with effective communication

**List of Exercises/List of Experiments: (9)**

1. Demonstration of robot configuration
2. Demonstration of robot with 2 dof, 3 dof, 4 dof etc.
3. Design/modeling of any two different types of grippers.
4. Two assignments on programming the robot for applications
5. Two programming exercises for robots
6. Exercise on welding robot in robot simulation software
7. Exercise on pick and place robot in robot simulation software
8. Exercise on robotic simulation software
9. Two case studies of applications in industry
10. Study of automation processes such as Distribution station, Testing station, Pick and place, Fluidicmuscle press, and Storing.
11. Study of PLC on Automation production system

12. Study of robotic end effectors, robotic arm and its configurations.
13. Design and testing of hydraulic circuits
14. Design and testing of pneumatic circuits
15. Simulation of basic hydraulic and pneumatic circuits

**SOFTWARE/Tools used:**

**.**Offline robot programming software

. Aristo Robotic Simulation Software

**IV B. Tech. – I Semester**

(19BT703AC) **MATLAB FOR MECHANICAL ENGINEERS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | - | - | 3 |

**PRE-REQUISITES:**

Courses on any programming language, Basic Engineering Mechanics, Mechanical Vibrations.

**COURSE DESCRIPTION:**

Basics of MATLAB; Functions for plotting; Programming in MATLAB; Application of MATLAB code in Engineering Mechanics and Mechanical Vibrations.

**COURSE OBJECTIVE:**

*CEO1: To impart knowledge on MATLAB for solving Mechanical Engineering applications.*

*CEO2: To develop programming skills in MATLAB for solving Mechanical Engineering applications.*

**COURSE OUTCOMES:**

After successful completion of this course, the students will be able to:

CO1: Demonstrate the syntax, built-in functions, mathematical operations of MATLAB.

CO2: Analyze the given data throughvisualization.

CO3: Analyzesyntax for preparingMATLAB script and function files.

CO4: DevelopMATLAB code forsolvingEngineering Mechanics problems.

CO5: DevelopMATLABcodeforsolvingMechanicalVibrations problems.

**DETAILED SYLLABUS:**

**UNIT- I: BASICS OF MATLAB (06 periods)**

Arithmetic operations with scalars, display formats, math built-in functions, Arrays, Mathematical operations with arrays**.**

**UNIT- II: PLOTING (06 periods)**

Plot of given data, plot of a function, multiple graphs in same plot, multiple plots in same page.

**UNIT-III: PROGRAMMING IN MATLAB (06 periods)**

Conditional statements, the switch-case statement, Loops, Nested loops, Nested conditional statements, break and continue commands, User defined Functions and Function files.

**UNIT-IV: MATLAB APPLICATION IN ENGINEERING MECHANICS (06 periods)**

Preparing MATLAB codes for Resultant and equilibrium force of coplanar force system, non-coplanar force system, friction problems, virtual work, kinematics of rigid body in plane motion, moment of inertia, work and energy,

**UNIT-V: MATLAB APPLICATION IN MECHANICAL VIBRATIONS (06 periods)**

Preparing MATLAB codes for Free and forced vibration of Single Degree of Freedom Systems, free vibration of damped system, modal analysis for undamped system

**Total Periods: 30**

**TEXT BOOKS:**


1. Rao V. Dukkipati, *MATLAB: An Introduction with Application*, New Age International Publishers, Second edition, 2010
2. Amos Gilat, *MATLAB: An Introduction with Applications*, John Wiley & Sons, Fourth Edition.


**REFERENCE BOOKS:**


1. Rudra Pratap. Getting Started With MATLAB, Oxford University Press. Seventh edition, 2019