IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Mechanical Engineering Department

B. Tech, VI Sem

Scheme

S. No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	PCC-ME601	PCC	I.C. Engine	70	20	10	60	40	200	2	1	2	4
2.	PCC-ME602	PCC	Mechanical Vibration	70	20	10	60	40	200	2	1	2	4
3.	PCC-ME603	PCC	Power Plant Engg.	70	20	10	-	-	100	3	1	0	4
4.	PEC - ME601	PEC	Elective – I	70	20	10	-	-	100	4	0	0	4
5.	OEC- ME601	OEC	Open Elective – II	70	20	10	-	-	100	3	0	0	3
6.	PROJ - ME601	PROJ	Seminar – I	-	-	-	-	100	100	0	0	2	1
Total Academic Engagements and Credits										**13**	**3**	**06**	**20**
Total				**350**	**100**	**50**	**120**	**180**	**800**	**13**	**3**	**06**	**20**

*MST: Minimum of two mid semester tests to be conducted. L: Lecture T: Tutorial P: Practical

S. No.	Elective-I	Open Elective-II
1	PEC-ME601 (A) Gas Dynamics	OEC – ME601 (A) Metro System & Engineering
2	PEC-ME601 (B) Dynamics of Machines	OEC – ME601 (B) Process Modeling and Simulation
3	PEC-ME601 (C) Engineering Metrology	OEC – ME601 (C) Fundamentals of Fire and Safety
4	PEC-ME601 (D) Production & Operation Management	OEC – ME601 (D) Basics of Python

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Syllabus

PCC – ME601	I.C. Engine	2L: 1T: 2P (5 Hrs)	04 Credits

Pre-requisite(s):
Nil

Course Objective's:
- To understand the operation of internal combustion engines.
- To perform theoretical calculations to obtain thermodynamic efficiencies and then assess operating losses.
- To calculate engine operating parameters.
- To understand the implications of a tradeoff between performance, efficiency, emissions.

Course Content:

Module 1 **(07 hrs)**

Introduction of IC Engine: Internal Combustion Engine: S.I. and C.I. engines of two and four stroke cycles, real cycle analysis of SI and CI engines, determination of engine dimensions, speed, fuel consumption, output, mean effective pressure, efficiency, factors effecting volumetric efficiency, heat balance, performance characteristics of SI and CI engines, cylinder arrangement, firing order, power balance for multi-cylinder engines.

Module-2 **(08 hrs)**

Combustion in SI engines: Flame development and propagation, Pressure-Crank Angle diagram, Stages of Combustion ignition lag, effect of air density, temperature, engine speed, turbulence and ignition timings, physical and chemical aspects, abnormal Combustion, effect of engine and fuel variables on abnormal combustion, pre-ignition, its causes and remedy, salient features of various type combustion chambers.

Module-3 **(07 hrs)**

Combustion in CI Engines: Various stages of combustion in CI Engines, delay period, diesel knock, knock inhibitors, salient features of various types of combustion chambers. Fuel injection in CI engine. Working Principle of fuel pump & fuel injectors, types of nozzles. Fuel injection in SI engine (MPFI, TBI, CRDI), Theory of carburetion, Solex Carburetor, simple problems on carburetion. Fuel metering in CI engines.

Module-4 **(07 hrs)**

Fuel & Combustion: Classification of IC Engine fuels, Desirable characteristics of SI & CI engine fuels, Rating of SI & CI engine fuels, Alternative fuels for SI and CI engine (liquid, gaseous, hydrogen, LPG, CNG, Biogas etc.), Air requirement, Analysis of combustion products, HHV and LHV of fuels. Actual and theoretical combustion process.

Module-5 **(07 hrs)**

Supercharging & Turbo charging: Methods of supercharging, & turbo charging effects of super charging and turbo charging. Engine Modifications for supercharging, supercharging of

two stroke engines. microprocessor controlled supercharging. Cooling & lubrication of SI & CI Engines.

Course Outcomes:

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

1. Discuss the knowledge of internal combustion engine components and fuel Air cycles, Actual and theoretical Cycle.
2. Evaluate the Normal and Abnormal combustion aspect of SI Engines.
3. Evaluate the Concept of Normal and Abnormal combustion aspect of CI Engines and design of combustion chamber
4. Utilize the concept of carburetion and working of Auxiliary system ignition system, Lubrication system Fuel injector and nozzle.
5. Explain the method of supercharging and turbo charging and their Importance.

Text Book:

1. R.K. Rajput, Internal Combustion Engines, Laxmi Publication.
2. V. Ganeshan, Internal Combustion Engines, McGraw Hill Publication.
3. Mathur & Sharma internal combustion engines, Dhanpat rai & sons

References:

1. J.B. Heywood. Internal combustion Engines, Wiley
2. Ganeshan V; Internal Combustion engines; TMH
3. Mathur M L & Sharma RP; A. Course in IC engines; Dhanpat Rai
4. R Yadav, Internal Combustion Engines, Central Publishing House.
5. Halderman JD and Mitchell CD; Automotive Engines theory and servicing; Pearson
6. Dom Kundwar; Internal Combustion Engines; Dhanpat Rai Publications
7. Taylor GF; Internal Combustion Engines Theory & Practice; MIT Press
8. Richard Stone; Introduction to IC Engines; Society of Automotive Engineers (Palgrave Mc Millan)

List of Experiments:

1. To Study the construction details & working principal of 2-Stroke / 4- Stroke Petrol Engine.
2. To study the constructional details & working principles involved in a 2-Stroke & 4-Stroke Diesel Engines.
3. To Prepare Heat Balance Sheet for a Single Cylinder Two Stroke Petrol Engine Test Rig with Electrical Dynamometer.
4. To draw the heat balance sheet of a Four Stroke Single Cylinder Diesel Engine Test Rig.
5. To draw the heat balance sheet and conduct a performance test on the Four Stroke Single Cylinder petrol Engine.
6. To Study and Determine the effect of A/F Ratio on the performance of the Two-Stroke, Single-Cylinder Petrol Engine.
7. To study and draw the valve timings diagram Four-Stroke, Single-Cylinder Diesel Engine.
8. Study of the lubrication and cooling system in IC Engine.
9. Study of carburetor.
10. Study of ignition system.

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PCC-ME602	Mechanical Vibration	2L:1T:2P (5 Hrs)	Credits: 04

Pre-requisite(s):
Theory of Machines

Course Objective's:
To dynamically analyze a mechanical system

Course Content:

Module 1: **(08 Hrs)**

Fundamental Aspects of Vibrations: Vibration and its causes, advantages and disadvantages; engineering applications of vibration; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic non- harmonic functions- Fourier series analysis; evaluation of coefficients of Fourier series; elements of vibratory system; lumped and distributed parameter systems.

Undamped Free Vibrations: Derivation of differential equation of motion: Systems involving angular oscillations: the compound pendulum.

Module 2: **(10 Hrs)**

Damped Vibrations: Viscous damping: coefficient of damping; damping ratio; under damped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous and Coulomb damping; solid and structural damping; slip or interfacial damping.

Module 3: **(10 Hrs)**

Harmonically excited Vibration: One degree of freedom- forced harmonic vibration; vector representation of forces; excitation due to rotating and reciprocating unbalance; vibration Isolation, force and motion transmissibility; absolute and relative motion of mass (Seismic Instruments). **Whirling Motion and Critical Speed** : Definitions and significance. Critical speed of a vertical, light flexible shaft with single rotor : with and without damping . Critical speed of a shaft carrying multiple discs (without damping), Secondary critical speed.

Module 4: **(08 Hrs)**

Systems with Muti-Degrees of Freedom: Un-damped free vibration of 2 d.o.f and Principal modes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic excitation ; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

Module 5: **(06 Hrs)**

Noise Engineering: Frequency and sound dependent human response; the decibel scale; relationship between, sound pressure level (SPL), sound power level and sound intensity scale; relationship between addition, subtraction and averaging, sound spectra and Octave band analysis; loudness; weighting networks; equivalent sound level, auditory effects of noise; hazardous noise, exposure due to machines and equipments; hearing conservation and damage risk criteria, daily noise doze.

Course Outcomes:

After completion of the course student will be able:

1. Find natural frequency of SDOF systems.
2. Categorise damped system as under damped or critically damped.
3. Deal with resonant condition.
4. Design and solve real world applications with increased DOF.
5. Design acoustically better applications (Based on SPL, Decibel Scale, Human Comfort Level etc.)

Text Books:

1. Mechanical Vibrations and Noise Engineering; Ambekar AG,3 e, 2006,PHI

Reference Books:

1. Mechanical Vibration , G.K. Grover, 8 e, Nem Chand Publishers.
2. Theory of Vibration with Applications, Thomson , W.T., 5-e, Pearson Education.

List of Experiment:

1. To find mass moment of inertia of a rod from its vibration as a compound pendulum.
2. To find damping coefficient and damped and undamped natural frequencies of an under-damped single degree of freedom system from its response to an initial displacement
3. To find MI of an object using Trifilar suspension.
4. To study, experimentally, the response of a SDOF system to harmonic excitation applied to the mass for different values of damping factor.
5. Tune a vibration absorber by varying dynamic system parameters.
6. To study the rotating imbalance and perform modal analysis of rotating shaft.

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PCC-ME603	Power Plant Engineering	3L:1T: 0P (04 hrs)	Credits: 04

Pre-requisite(s): Nil

Course Objective's:

To introduce students to different aspects of power plant engineering. To familiarize the students to the working of power plants based on different fuels. To expose the students to the principles of safety and environmental issues.

Course Content:

Module 1 **(07 hrs)**

Introduction: Introduction to methods of converting various energy sources to electric power, direct conversion methods renewable energy sources, solar, wind, tidal, geothermal, bio-thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter

Module 2 **(08 hrs)**

Fossil fuel steam stations: Basic principles of sitting and station design, effect of climatic factors on station and equipment design, choice of steam cycle and main equipment, recent trends in turbine and boiler sizes and steam conditions, plant design and layout, outdoor and indoor plant, system components, fuel handling, burning systems, element of feed water treatment plant, condensing plant and circulating water systems, cooling towers, turbine room and auxiliary plant equipment., instrumentation, testing and plant heat balance.

Module 3 **(08 hrs)**

Nuclear Power Station: Importance of nuclear power development in the world and Indian context, Review of atomic structure and radio activity, binding energy concept, fission and fusion reaction, fissionable and fertile materials, thermal neutron fission, important nuclear fuels, moderators and coolants, their relative merits, thermal and fast breeder reactors, principles of reactor control, safety and reliability features.

Module 4 **(07 hrs)**

Hydro-Power Station: Elements of Hydrological computations, rainfall run off, flow and power duration curves, mass curves, storage capacity, salient features of various types of hydro stations, component such as dams, spillways, intake systems, head works, pressure tunnels, penstocks, reservoir, balancing reservoirs, Micro and pico hydro machines, selection of hydraulic turbines for power stations, selection of site.

Module 5 **(08 hrs)**

Power Station Economics: Estimation and prediction of load. Maximum demand, load factor, diversity factor, plant factor and their influence on plant design, operation and economics; comparison of hydro and nuclear power plants typical cost structures, simple problems on cost analysis, economic performance and tariffs, interconnected system and their advantages, elements of load dispatch in interconnected systems.

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Course Outcomes:

After completion of the course student will be able:

1. Understand the conversion of renewable energy system into electrical power.
2. Design & enhance the performance of fossil fuel based power plant.
3. Analyze the nuclear power plant and its safety
4. Design & enhance the performance of hydro based power plant.
5. Determine economics of the power plant of renewable and non renewable / nuclear power system

Text Books:

1. Rajput RK; A text book of Power plant Engg.; Laxmi Publications.

Reference Books:

1. Nag PK; Power plant Engg; TMH
2. Al-Wakil MM; Power plant Technology; TMH
3. Sharma PC; Power plant Engg; Kataria and sons, Delhi
4. Domkundwar; Power Plant Engg; Dhanpatrai & sons.

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PEC-ME601(A)	Gas Dynamics	3L: 0T: 0P (3 Hrs)	Credits: 04

Pre-requisite(s):

Thermodynamics, Applied Thermodynamics and Fluid Mechanics.

Course Objective's:

To apply fundamental knowledge of thermodynamics for thermal performance of steam turbine, gas turbine, jet engine and their significance.

Course Content:

Module 1: **(08 Hrs)**

Gas Turbine: Introduction of gas turbine cycle, types of gas turbine plants, performance of open and closed cycle plant, Gas turbine with Intercooling, reheating and regeneration, cycle with combination of all parameters.

Module 2: **(09 Hrs)**

Compressible fluid Flow: Speed of sound, in a fluid mach number, mach cone, stagnation properties, one dimensional isentropic flow of ideal gases through variable area duct-mach number variation, area ratio as a function of mach number, mass flow rate and critical pressure ratio, effect of friction, velocity coefficient, coefficient of discharge, diffusers, normal shock.

Module 3: **(08 Hrs)**

Steady Supersonic two Dimensional flows: Two dimensional equations with and without conservative form, Mach waves, and oblique shock waves, Small Disturbance theory, centered Prandtl- Meyer rarefaction, supersonic flow of airfoils.

Module 4: **(09 Hrs)**

Steam Turbines: Types of turbines, Compounding, Velocity diagrams, Performance analysis, Reheat factor, Stage efficiency, Governing, and Losses in turbines, Problem based on their performance with velocity diagram.

Module 5: **(09 Hrs)**

Jet Propulsion: Jet Propulsion- Turbo jet, Turbo Prop, Ram jet, Rocket engines thrust power, propulsive efficiency and thermal efficiency, Jet propulsion performance, Specifying thrust and specific fuel consumption in each case for turbo jet and turbo propulsion units.

Course Outcomes

After completion of the course the students are able to:

1. Explain the types of gas turbine plant and their performance with operating characteristics.

2. Understand the concepts of one dimensional compressible fluid flow and Stagnation properties.
3. Understand the concepts of two dimensional compressible fluid flow and supersonic flow of airfoils.
4. Evaluate thermal performance of Steam turbine with Velocity diagram.
5. Understand the Concept of jet Propulsion and their application.

Text Book:

1. Yadav R., "Steam and Gas Turbines" Central publishing House.
2. S. C. Gupta, Thermal Engineering, Pearson Education.
3. D. S. Kumar, Thermal Science and Engineering, S. K Kataria & Sons
4. Mahesh M Rathore, Thermal Engineering , TMH
5. Nag P K, Engineering Thermodynamic, TMH

Reference Books:

1. T. D. Eastop and A. McConkey, "Applied Thermodynamics", Addison Wesley Longman.
2. Cengel and Boles, Thermodynamics: An Engineering Approach (Mechanical Engineering), McGraw Hills.
3. Sonntag, Van Wylen, fundamentals of Thermodynamics, Willy Edition.

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PEC-ME-601(B)	Dynamics of Machine	3L:0T: 0P (04 hrs)	Credits: 04

Pre-requisite's:
Theory of Machine

Course Objective's:
To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations. Develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments. .

Course Content:

Module 1 **(09 Hrs)**

Dynamics of Engine Mechanisms: Displacement, velocity and acceleration of piston; turning moment on crankshaft, turning moment diagram; fluctuation of crankshaft speed, analysis of flywheel and Punching Press.

Module 2 **(07 Hrs)**

Governor Mechanisms: Types of governors, characteristics of centrifugal governors, gravity and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors.

Module 3 **(11 Hrs)**

Balancing of Inertia Forces and Moments in Machines: Balancing of rotating masses, two plane balancing, determination of balancing masses (graphical and analytical methods), balancing of rotors, balancing of internal combustion engines (single cylinder engines, in-line engines, V-twin engines, radial engines, Lanchester technique of engine balancing.

Module 4 **(07 Hrs)**

Friction: Frictional torque in pivots and collars by uniform pressure and uniform wear rate criteria. Boundary and fluid film lubrication, friction in journal and thrust bearings, concept of friction circle and axis, rolling friction.

Module 5 **(08 Hrs)**

Brakes: Band brake, block brakes, Internal and external shoe brakes, braking of vehicles. Dynamometer: Different types and their applications.

Dynamic Analysis of Cams: Response of un-damped cam mechanism (analytical method), follower response analysis by phase-plane method, jump and cross-over shock.

Course Outcomes:
After completion of this course, students will be able to:

1. Apply an understanding of analytical and graphical approach to engineering problems of turning moment.
2. Understanding the theoretical and practical concepts behind working of Governors and their application for various functions.
3. Analyzing the balancing of rotating masses that can be used in different machineries.

4. Understanding the working principle of pivots and frictional behavior of these pivots and collars.
5. Understand about different brakes and also function of different dynamometer.

Text Books:

1. Ambekar, AG; Mechanism and Machine Theory; PHI
2. Rattan SS; Theory of machines; TMH
3. Sharma and Purohit; Design of Machine elements; PHI
4. Bevan; Theory of Machines.

Reference Books:

1. Ghosh and Mallik; Theory of Mechanisms and Machines; Affiliated East-West Press, Delhi
2. Norton RL; kinematics and dynamics of machinery; TMH
3.Grover; Mechanical Vibrations
4. Balaney; Theory of Machines by
5.Theory of Vibrations by Thomson

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PEC -ME601 (C)	Engineering Metrology	4L: 0T: 0P (04 hrs.)	Credits: 04

Pre requisite(s):

Manufacturing Process & Manufacturing Technology

Course Objectives:

1. To Understand metrology, its advancements & measuring instruments,
2. To Acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements, Screw thread and gear measurement & comparators.
3. To know about Measurement of surface roughness.
4. Equip with knowledge of limits, fits, tolerances and gauging.
5. To understand the Pre and Post Production Analysis.

Course Content:

Module 1: **(10 Hrs)**

Metrology : Introduction to Metrology: Definition, objectives and concept of metrology, Need of inspection, Principles, process, methods of measurement, Classification and selection of measuring instruments and systems. Accuracy, precision and errors in measurement. System of measurement, Material Standard, Wavelength Standards, Subdivision of standards, Line and End standards, Classification of standards and Traceability, calibration of End bars (Numericals), standardization.

Module 2: **(12 Hrs)**

Measuring Instruments : Linear measurement - Direct measuring tools, Comparators, Types, use and limitations, Optical Instruments, Projectors, Tool makers microscope, Sine bar, Angle gauge clinometers, Optical dividing head. Measurement and representation of Geometrical Features: Measurement of straightness, Flatness, Parallelism, Perpendicularity, Roundness, Cylindricity, Squareness and Symmetry, Interferometry and its applications.

Module 3: **(08 Hrs)**

Measurement of Surface Roughness: Measurement of surface roughness, E & M System, Surface roughness in various manufacturing processes. Measurement of Screw, Threads and Gears : Measurement of elements of screw, threads, pitch and effective diameter measurement and errors in screw threads elements and their effect, Inspection of gears, Various methods of measuring gear tooth thickness, Measurement of base pitch, PCD and profile, lead and roll testing

Module 4: **(10 Hrs)**

Interchangeability: Concept of limits fits and tolerances, Types of fits, Universal and local interchangeability, Systems of limits, fits and tolerances, Selective assembly and matched fits, B.S., I.S.O. and I.S. systems. Design of limit gauges, Types and their manufacture. In process inspection and control

Module 5: **(10 Hrs)**

Manufacturing Analysis: Pre and Post Production Analysis, Process Planning, Part Print Analysis, Determination of Principle Processes, Blank making process, Determination of Functional surfaces of W/pc, Machining Allowances (limits of size for initial and intermediate W/pc dimensions). Work- piece control, Influence of Process Engineering on product design.

Course Outcome's:

After completion of the course student will be able:

1. Understand the objectives of metrology and its importance.
2. Describe slip gauges, wringing of slip gauges and building of slip gauges, angle measurement using sine bar.
3. Understand the gear measurement techniques.
4. Understand with concept of interchangeability.
5. Understand with concept of pre and post production analysis.

Text Books:

1. Gupta I. C., Metrology, Dhanpat Rai & Sons, New Delhi, India., 2004
2. Jain R. K., Metrology, Khanna Publishers, New Delhi, India .1984
3. Hume K. J., Engineering Metrology, McDonald, California, USA , 2015.
4. Thomas G Beckwith, N Lewis Buck and Roy D Marargoni, "Mechanical Measurements", Narosa publishing house, 1989.
5. Harshavardhan, "Measurements – Principles and Practice", Macmillan India Limited, 1993

Reference Books :

1. Turner, J.D., "Instrumentation for Engineers", Springer – Verlag, New yorkinc, 1988.
2. B.C.Nakra and Chaudhry, K.K., "Instrumentation and Analysis", TMH, 1985.
3. Doeblin E.O., Measurement Systems, McGraw-Hill, 2004.
4. John Bank, The Essence of Total Quality Management, Prentice Hall of India, 1998.
5. James I Bossert, Quality Function Deployment, ASQC quality press, Wisconsin, 1994.

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PEC - ME601(D)	Production & Operation Management	4L: 0T: 0P (04 Hrs)	Credits: 04

Pre requisite(s):

Production process

Course Objectives:

1. To introduces the role of production management.
2. To introduces the concept of Plant layout and Material Handling.
3. To introduces the Strategies of Aggregate Planning
4. To know about maintenance procedure.
5. The course further introduces the scope of material management.

Course Content:

Module 1: **(10 Hrs)**

Production Management: Introduction, Systems concept, Decisions, Organization, Objectives and Evolution of Operations Management, Operations Strategy, Type of Production Systems. Role of Production Manager.

Module 2: **(10 Hrs)**

Facilities Planning & PPC: Plant location, Plant layout and Material Handling, Layout analysis, Procedures such as CORELAP, CRAFT etc. Organization & Functions of PPC CAPP, Make or Buy Decision, Forecasting Methods & its relationship with Product Life Cycle, Case Studies.

Module 3: **(10 Hrs)**

Aggregate Planning and Master Scheduling: Strategies of Aggregate Planning, Graphic & and Charting methods, Application of LP, Master Scheduling, Job Shop Scheduling and Sequencing Algorithms Gantt Chart, Line Balancing, LOB, Case Studies.

Module 4: **(10 Hrs)**

Maintenance Management: Types of maintenance strategies, Breakdown, Preventive and Predictive maintenance, Individual and Group Replacement Policies, Case Studies.

Module 5: **(10 Hrs)**

Materials Management: Purchasing, stores and vendor selection, Inventory Models, Selective Inventory Control, MRP, MRP-II, Lot size Techniques, Just - In - Time system of manufacturing, Kaizen, Total Productive Maintenance (TPM) . BPR, SCM, ERP etc. & Case Studies.

Course Outcomes:

After completion of the course student will be able:

1. To understand concept of production & operation management.
2. To understand & design the plant layout and Material Handling.

3. To understand the aggregate planning and master scheduling.
4. To understand maintenance procedure used in industry.
5. To understand the the concept of MRP I & MRP II.

Text Books:

1. Chitle A.K., Gupta R.C. Materials Management, PHI. 3rd Ed.2014.
2. Charry S.N., Production & Operations Management. TMH. 14th Reprint, 2007.
3. Chase, Acquilino, Production & Operations Management, TMH.1998.

Reference Books :

1. Dobler & Lee, Purchasing & Materials Management, PHI.1984.
2. Eilon S. Elements of Production Planning and Control, McMillon Pub. 1991.
3. Mike Pycraft , Operations Management. Pearson Education, 2000.

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OEC - ME601(A)	Metro System & Engineering	3L: 0T: 0P (3 Hrs)	Credits: 03

Prerequisite: Electronics, Mechanical Engineering & Civil Engineering.

Course Objective: The objective of this course is that students can learn fundamental concepts of electronic circuits together with concepts of Civil and Mechanical engineering for designing of metro systems.

Course Content:

Module 1 **(8 Hrs)**

Difference between metro and rail system: Signal protocols in railways, Types of Signals in electronics system, LED, Power supply, Microcontroller and Microprocessor, General introduction to IC, IC555, IC741 etc. and their datasheets. Automatic door system in metro, GPS, Servo motor, RFID, Passenger information system, LCD, IVRS, Wacky Tacky, AM, FM modulation.

Module 2 **(8 Hrs)**

Overview of metro systems: Different engineering materials, stress strain analysis, Different mechanism, Basics of vehicle dynamics and structure, types of braking system and suspension system, Basics of refrigeration system, Ventilation of mainline rail tunnels, Tunnel Ventilation systems; Air conditioning for stations and buildings.

Module 3 **(8 Hrs)**

Development on standardization of metro system:- Overview of Metro Systems, introduction of Indian Metro, How it began, India's 1st and Asia's 5th metro rail, Existing, future & proposed metro, Need for Metros, Benefits of metro rail, Types of metro rail, Advantages of metro rail, disadvantages of metro rail, routing studies, Basic Planning and Financials.

Module 4 **(8 Hrs)**

Metro Planning and Selection:- Basics of Construction Planning & Management, Construction Quality & Safety Systems, Traffic integration, multimodal transfers and pedestrian facilities, Environmental and social safeguards, Track systems-permanent way, Facilities Management, Metro Maintenance, Introduction of metro act, Report of Ministry of Urban Development on standardization of metro system.

Module 5 **(8 Hrs)**

Metro Survey & Construction:- Initial Surveys & Investigations, Overview and construction methods for Elevated and underground Stations, Viaduct spans and bridges, Underground tunnels, tunnel ventilation systems, air -conditioning for stations and buildings, Metro Signaling, Fire control systems, Lifts and Escalators.

Course Outcome:

1. To apply knowledge of various types of signals and demonstrate various types of electronic components.
2. Explain different mechanism and vehicle dynamics of metro systems.

3. To understand overview of metro systems & acquire the necessity of elevated structures in railways and metro construction system.

4. To understand integrated operation of metro system & understand cost effectiveness of various urban transport systems & working.

5. To understand basics of construction planning & management, construction quality & safety systems

Text/ Reference Books:

1. Rey Bhurchandi, "Advanced Microprocessor Architecture", 2nd edition, TMH, 2001.
2. B.P. Lathi, "Modern Digital and Analog Communication System", TMH.
3. M. Morris Mano, "Digital Logic and Computer Design", 1st edition, Pearson India Education, 2012.
4. Ramakant A Gaikward, "OP- Amp and linear Integrated circuits", Third edition 2006, Pearson.
5. Fundamentals of Vehicle Dynamics by Thomas D. Gillespie, published by SAE International with a Product Code of R-114, ISBN of 978-1-56091-199-9.
6. Civil Engineering For Underground Rail Transport, J.T. Edwards (Chairman, Halcrow Fox and Associates; formerly Senior Partner, Freeman Fox and Partners).
7. Handbook of Research on Emerging Innovations in Rail Transportation Engineering, B. Umesh Rai (Chennai Metro Rail Limited, India).
8. Metro Act - Government of India – 2002.
9. Rolling Stock - Report of Ministry of Urban Development – GOI -2013.
10. Radio communication for Communications-Based Train Control (CBTC): A tutorial and survey – 2017.
11. Technical Details of Metro Rolling Stock, Ansaldo Manual – 2016.
12. Technical Details of Metro Rolling Stock – Bombardier – 2015.
13. Technical Standards of Track Structure for Metro Railways/MRTS – RDSO.
14. Detailed Project Reports of Various Metro Projects in India – By Delhi Metro Rail Corporation.
15. Manual of Specifications

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OEC - ME601(B)	Process Modeling & Simulation	3L: 0T: 0P (3 Hrs)	Credits: 03

Course Content

Module 1 **(06 Hrs)**

The role of analysis: chemical engineering problems, basic concepts of analysis; the analysis process, simple example of estimating an order, source of the model equations, conservation equations, constitutive equations, control volumes, dimensional analysis, system of units, dimensional consistency in mathematical descriptions, dimensional analysis and constitutive relationships, final observations.

Module 2

Non-Reacting Liquid Systems: Introduction, equation of continuity, simple mass balance, application of the model equations, component mass balances, model behavior: steady state behavior, un-steady state behavior, density assumption, numerical integration methods of ordinary differential equation; Reacting Liquid Systems: Introduction, basic model equations for a tank-type reactor, reaction rate, batch reactor, pseudo first-order reactions, reversible reactions, multiple reactions; consecutive reactions, parallel reactions, complex reactions, constant density assumption, order and stochiometry.

Module 3

Treatment of experimental data: Introduction, criteria for Best Fit, Best Slope-I, Best Slope-II, Best straight line, physical property correlations, fitting a quadratic, simulation examples of gravity fluid flow, heat and mass transfer, Monte-Carlo simulation.

Module 4

Dynamic modeling of simple processes, sequential, simultaneous modular and equation oriented approaches, partitioning and tearing.

Module 5

Computer programming of various iterative convergence methods such as Newton Ralphson, false position, Wegstein, Muller methods.

References:

1. Russell TWF; Introduction to Chemical Engineering Analysis - John Wiley & Sons
2. Luyben W.L; Process Modeling, Simulation And Control For Chemical Engineers; TMH
3. Jana ; Jana ; Chemical process modeling and computer simulation; PHI Learning

IPS Academy, Institute of Engineering & Science

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Mechanical Engineering Department

B. Tech, VI Sem

OEC - ME601(C)	Fundamentals of Fire and Safety	3L: 0T: 0P (3 Hrs)	Credits: 03

Course Objective:
To understand and learn the basic essentials fundamentals in fire technology & safety engineering discipline.

Course Content:

Module 1 **(08 Hrs)**

Basics of Fire & Fire Science: Chemistry and Physics of Fire, Theory of Fire Extinguishment, combustion process, extinguishment with water, extinguishment with aqueous foams, extinguishment with water mist, extinguishment with inert gases, extinguishment with halogenated agents.

Module 2 **(08 Hrs)**

Fundamentals of Fire Detection- simplified fire development, fire signatures, characteristics of fire signatures, aerosol signatures, energy release signatures, gas signatures, other fire signatures, basics of passive fire protection, stages of fire development, flame spread, Smoke and Toxicity.

Module 3 **(08 Hrs)**

Fire Fighting Installation: Water Based Fire Protection, Hydrant system, Automatic Sprinkler System, High Velocity Water spray system, Foam Based Fire Protection, Gas Based Fire Protection, Co2 flooding system, Co2 local application system, Dry Chemical Based Fire Protection System, DCP fixed installation and local application system.

Module 4 **(08 Hrs)**

Industrial Labour Legislation: Labour Legislations in India-Principles of Labour Legislation-Social Justice, Social Equity, National Economy. Classification of Labour Laws Purpose, Legislature, Period Of Enactment. The Factories Act, 1948-Main Provisions of The Act, Health And Hygiene (Sec11-20), Safety Provisions (Sec 21- 41)

Module 5 **(08 Hrs)**

Accident Investigation and Reporting- Concept of an accident, Reportable and non reportable accidents, Reporting to statutory authorities, Principles of accident prevention, Accident investigation and analysis, Records for accidents, Departmental accident reports, Documentation of accidents, Unsafe act and condition, Domino sequence, Supervisory role, Role of safety committee, Cost of accident.

Course Outcomes: At the end of this course student will be able to:

1. Apply fundamental concepts of fire and its extinguishment.
2. Understand the fundamentals of fire detection & interpret in fire detection system design.
3. Understand various types of fire fighting installation.
4. Know about industrial labour legislation.
5. Understand accident investigation and reporting process.

List of Text/Reference Books:

1. Heinrich H.W. Industrial Accident Prevention McGraw - Hill Company, New York,1980.
2. Krishnan N.V. Safety Management in Industry Jaico Publishing House, Bombay,1997.
3. Lees, F.P., Loss Prevention in Process Industries Butterworth publications, London, 2nd edition, 1990.
4. John Ridley, Safety at Work, Butterworth and Co., London, 1983.
5. Fred Stowell, Principles of Foam Fire Fighting International Fire Service Training Association.
6. Robert M Gagnon, Designer's Guide to Automatic Sprinkler Systems, NFPA-2005.
7. Operation of Fire Protection System NFPA Special Edition.
8. Tariff Advisory committee, Fire Protection Manual- Hydrant System.

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Mechanical Engineering Department

B. Tech, VI Sem

OEC-ME601(D)	Basics of Python	3L : 0T : 0P (3 hrs.)	Credits:03

Prerequisite: Nil

Course Objective:

The course is designed to provide Basic knowledge of Python. Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language. Learning Outcomes: Problem solving and programming capability

Course Content

Module 1: (07 hrs)

Introduction, History, Features, Python –Environment Setup Local Environment Setup, Getting Python, Installation of Python, Use of IDE

Module 2: (10 hrs)

Python –Basic Syntax Python Identifiers, Reserved Words, Lines & Indentation, Multiline Statements, Quotation in Python, Comments & other useful constructs, Python –Variables Assigning Values to Variables, Multiple Assignment, Standard Data Types

Module 3: (08 hrs.)

Python –Variables, Assigning Values to Variables, Multiple Assignment, Standard Data Types; Python Numbers, Python Strings, Python Lists, Python Tuples, Dictionary, DataType Conversion

Module 4: (08 hrs.)

Python –Basic Operators, Types of Operators, Arithmetic Operators, Comparison Operators, Assignment Operators, Bitwise Operators, Logical Operators, Operator Precedence, Python – Decision Making & Loops, Flowchart, If statement Syntax

Module 5: (08 hrs.)

Python-Functions, Syntax for defining a function, Calling a Function, Function Arguments, Anonymous Functions Python-Applications & Further Extensions, Data analysis packages.

Course Outcome:

After completion of the course student will be able to:

1. Install Python and have knowledge of syntax of Python.
2. Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python.
3. Express different Decision Making statements and Functions.
4. Develop code in Python using functions, loop set.
5. Design GUI Applications in Python and evaluate different database operations.

List of Text Books / Reference Books:

1. Eric Matthes, “Python Crash Course: A Hands-On, Project-Based Introduction to Programming”, No Starch Press.
2. ZedA. Shaw, “Learn Python the Hard Way” (3rdEdition), Addison Wesley.
3. Paul Barry, “Head-First Python”, O’Reilly.
4. John Zelle, Franklin ,”Python Programming”, Beedle & Associates Inc.

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Mechanical Engineering Department

B. Tech, VI Sem

PROJ-ME601	**Seminar - I**	**0L:0T: 2P (04 hrs)**	**Credits:01**

Before the end of semester, each student will have to deliver a seminar on a subject mutually decided by candidate and his/her guide. The student should select the topic for his/her seminar other than project work. The seminar topic should be latest and ahead of the scope of curriculum. The student, as a part of the term work, should submit the write-up of the seminar topic in duplicate, typed on A4 size sheet in a prescribed format and bound at the end of semester. The performance of the student will be evaluated on the basis of the contents, the presentation and discussion during the delivery of sem.

Course Outcome:

After completion of the course student will be able to:

1. Establish motivation for any topic of interest and develop a thought process for technical presentation.
2. Organize a detailed literature survey and build a document with respect to technical publications.
3. Effective presentation and improve soft skills.