Course Curriculum

(Course Structure and Syllabi)
for
MINOR DEGREE
in
Mechanical Engineering

Department of Mechanical Engineering

National Institute of Technology Hamirpur

Hamirpur – 177 005 (India)

Teaching Scheme for Minor Degree in Mechanical Engineering

SN	Code	Subject	Semester	L	T	P	Credits
1	ME-310	Heat and Power Engineering	5^{th}	3	0	0	3
2	ME-320	Mechanical Mechanisms and Design	6^{th}	3	0	0	3
3	ME-410	Manufacturing Science and Technology	7^{th}	3	0	0	3
4	ME-420	Production and Operation Management	8^{th}	3	0	0	3
Total Credits							12

Syllabus for Minor Courses

Semester 5th

Course Name: **Heat and Power Engineering**
Course Code: **ME-310**
Course Type: **Minor**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To carry out the thermodynamic analysis of vapour power cycle.
- To introduce the principles of boilers, condensers, and cooling towers.
- To introduce about the air compressors, steam nozzles and steam turbines.

Unit Number	Course Content	Contact Hours
UNIT-01	**Vapor Cycles:** Phase Change Cycles: Vapor Carnot cycle and its limitation, Rankin cycle, effect of boiler and Condenser pressure and superheat on end moisture and efficiency of Ranking cycle, modified Rankine cycle, reheat cycle, perfect regenerative cycle, Ideal and actual regenerative cycle with single and multiple heaters, open and closed type of feed water heaters, regenerative-reheat cycle, supercritical pressure and binary-vapor cycle, work done and efficiency calculations.	**07**
UNIT-02	**Steam Generators and Boilers:** Steam generators: classification, conventional boilers, high-pressure boilers-Lamont, Benson, Loeffler and Velox steam generators, performance and rating of boilers, equivalent evaporation, boiler efficiency, heat balance sheet, combustion in boilers, super critical boilers, fuel and ash handling, boiler draught.	**06**
UNIT -03	**Condensers and Cooling Tower:** Dalton's Law of Partial Pressure, Introduction- Necessity of Condensers, Classification of Steam Condensers, Construction and working of surface and jet condensers, Sources of Air in the Condenser, Condenser Vacuum, Vacuum Efficiency of Condenser, Condenser Efficiency, function of Cooling Towers in Condenser, Construction and working of natural, forced, and induced cooling towers.	**06**
UNIT-04	**Air Compressors:** Air compressors: working of reciprocating compressor, work input for single stage compression different, compression processes, effect of clearance, volumetric efficiency real indicator diagram, isentropic & isothermal and mechanical efficiency, multi-stage compression, inter - cooling, condition for minimum work done, classification and working of rotary compressors.	**06**
UNIT-05	**Steam Nozzles and Turbines:** Steam nozzles: isentropic flow of vapors, flow of steam through nozzles, condition for maximum	**07**

	discharge, effect of friction, super-saturated flow. Classification and performance of Steam Turbines, Compounding of turbines.	

Course Outcomes

Upon successful completion of the course, the students will be able to
CO1: Identify and predict the behavior of Vapour Power Cycle.
CO2: Determine the performance of boilers, condensers, and cooling towers.
CO3: Determine the performance of air compressors, steam nozzles and Steam turbines

Recommended Books

1. Fundamentals of Thermal-fluid Sciences - Yunus A. Çengel, Robert H. Turner-TMH.
2. Thermal Engineering -K Soman-PHI Publishers.
3. Applied Thermodynamics by Onkar Singh, New Age International Publishers.
4. Thermal Engineering by Mahesh M Rathore-TMH Publishers.
5. Power Plant Engineering by PK Nag, TMH Publishers.

Semester 6th

Course Name: **Mechanical Mechanisms and Design**
Course Code: **ME-320**
Course Type: **Minor**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart concept of stress, strain, Mohr Circle and Theories of failure.
- To impart concept associated with mechanisms, friction devices, Cam-Followers and Gears.
- To impart knowledge on balancing of machines.
- To impart fundamental knowledge of design principles in context of Mechanical Engineering.

Unit Number	Course Content	Contact Hours
UNIT-01	**Mechanics of Solids:** Stress-strain relationships, Deformation of axially loaded bars, Poisson's Ratio, Elastic relationship between Elastic Constants, Thermal strain and deformation, Definition of plane stress, plane strain and their examples, Principal stress and Principal strains, Mohr's circle representation of principal stress and strains. Introduction to theories of failure, Application of theories of elastic failure, Factor of safety in design.	**08**
UNIT-02	**Kinematics of Machines:** Kinematic Links, Kinematic Pairs, Constrained Motions, Degree of Freedom Classification of Kinematic Pairs, Kinematic Chain, Mechanism, Planar Mechanism, Grubler's Criteria for Plane Mechanisms, Four Bar Chain, Inversion of Mechanism, Introduction to friction devices (Clutches, Belt Drives, Rope Drives, Brakes and Dynamometer), Introduction to Cams and Followers, Types of Gears, Terminology, Fundamental Law of Gearing.	**08**
UNIT-03	**Dynamics of Machines:** D-Alembert's Principle, Velocity and Force Analysis, Forces on Reciprocating Parts of Engine, Equivalent Dynamical System, Balancing of Rotating Masses in One Plane and in Different Parallel Planes, Balancing of Reciprocating Masses, Introduction to the concepts of Governor, Concept of Gyroscopes, and applications.	**09**
UNIT-04	**Machine Design:** Engineering Design, Phases of Design, Design Considerations, Design against Static Load, Design against Dynamic load, Design of Solid and Hollow Shafts, Design of Keys and Splines, Design of Helical Springs, Design of Spur Gear.	**09**

Course Outcomes

Upon successful completion of the course, the students will be able to
CO1: Understand the concept of stress, strain, Mohr's circle, and theories of failure.
CO2: Identify link, pair, chain, joints, and inversions of mechanisms.

CO3: Understand the underlying theory and principles for various friction devices and their aplications
CO3: Identify the problems associated with unbalance in machines.
CO4: Acquire knowledge in designing various machine elements exposed to static, dynamic loads.

Recommended Books

1. Strength of Materials by Timoshenko, McGraw Hill.
2. Mechanics of Materials by E.J. Hearn, Butterworth-Heinemann.
3. Theory of Machines by S.S Rattan, McGraw Hill.
4. Theory of Machines by Thomas Bevan, CBS Publishers & Distributors.
5. Machine Design by Shigley, McGraw Hill.

Semester 7th

Course Name: **Manufacturing Science and Technology**
Course Code: **ME-410**
Course Type: **Minor**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the different manufacturing processes to produce products from raw materials.
- To introduce the fundamental concepts of metal casting, metal forming, powder metallurgy, machining, joining and additive manufacturing processes.
- To enable the students to select a suitable manufacturing process based on product requirements, productivity, mechanical properties, etc.

Unit Number	Course Content	Contact Hours
UNIT- 01	**Introduction:** Introduction to Manufacturing, General Trends in Manufacturing, Responsibility of Manufacturing Engineer, Classification in Manufacturing: Shaping, Machining, Joining and Treatment, Materials in Manufacturing.	**2**
UNIT-02	**Metal Casting Processes:** Need and Classification, Expendable Green Sand Mould Casting, Die-Casting, Patterns, Gating System, Solidification time of Casting, Riser, Casting Defects, and Inspection of Casting. **Metal Forming Processes:** Overview of plastic deformation, Bulk deformation processes: Forging, Rolling, Drawing, Extrusion, Sheet Metal Forming: Blank preparation by sheet cutting, Deep Drawing, Shearing, Punching operations. Introduction to Powder Metallurgy. **Conventional Machining Processes:** Need and classification, basics of single and multi-point cutting operations, tool geometry and tool materials. Grinding operation and its classification.	**12**
UNIT-03	**Joining Processes:** Need and Classifications of Joining Processes; Various Welding processes; Electric Arc Welding, Gas Welding: Oxy Acetylene welding; Thermit Welding, Brazing and Soldering**.**	**4**
UNIT-04	**Advanced Machining Processes:** Need and classification, Overview of mechanism, machining setup and applications of Jet Advanced Machining Processes (AJM, WJM, AWJM), USM process, Thero-electric Advanced Machining Processes (EDM, LBM) and ECM process.	**10**
UNIT-05	**Numerical Control of Machine Tools:** Introduction and need of Numerical control, basic elements, and Computer Numerical Control of Turning and Milling operations. **Additive Manufacturing Processes:** Introduction, Overview of Stereo Lithography (SLA), Selective Laser Sintering and Melting (SLS & SLM) and Three-Dimensional Printing (TDP), Fused Deposition	**5**

	Modelling (FDM) and Laminated Object Manufacturing (LOM)	

Course Outcomes:

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

CO1: Identify the process requirements to manufacture a specific product by casting, plastic moulding, powder metallurgy and metal forming, machining, and additive processes.

CO2: Describe the effects of various parameters on the quality of the product produced.

CO3: Identify the suitable process for the manufacturing of a product and write CNC codes for turning and milling.

Books and References

1. Fundamentals of Modern Manufacturing: Materials Processes and Systems by M. P. Groover, John Wiley and Sons, New Delhi.
2. Manufacturing Science by Ghosh and Mallik, East West Press Pvt. Ltd., New Delhi
3. Fundamentals of Metal Forming Processes by Juneja, New Age Inc. Publisher.
4. Advanced Machining Processes by V. K. Jain, Allied Publishers.
5. Manufacturing Engineering and Technology by Kalpakjian and Schmid, Pearson Education Pvt. Ltd. New Delhi.
6. Welding Processes and Technology by R.S. Parmar, Khanna Publishers, New Delhi

Semester 8th

Course Name: **Production and Operations Management**
Course Code: **ME-420**
Course Type: **Minor**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To understand the core features of the operations and production management function in an organization.
- Able to execute operations management functions.
- Make forecasts in the manufacturing and service sectors using quantitative and qualitative techniques.
- To understand the concept of Quality in Manufacturing and Service sector.

Unit Number	Course Content	Contact Hours
UNIT-01	**Introduction:** Manufacturing Vs Service Operations, System view of Operations, Strategic Role of Operations, Operations Strategies for Competitive Advantage, Operations Quality and Productivity Focus, Designing Products, Services and Processes: New Product Design-Product Life Cycle, Product Development Process, Types of production systems- Project, Job-shop, Batch, and Continuous.	**06**
UNIT-02	**Forecasting and Inventory Control:** Forecasting: Patterns of a time series – trend, cyclical, seasonal and irregular; Forecasting techniques: moving average, simple exponential smoothing, linear regression; Forecasting a time series with trend and seasonal component. Inventory control: Types of inventories, EOQ model, Economic lot size model, ABC analysis; Just-in-time inventory management, MRP concept – bill of materials (BOM).	**07**
UNIT-03	**Operations Scheduling:** Operations Scheduling: Concepts, loading, scheduling, and sequencing, job shop scheduling, scheduling criteria; Gantt charts. Types of scheduling – Forward and Backward Scheduling, Job shop Scheduling and Johnson's rule – n jobs and 2 machines, n jobs and 3 machines – n jobs and m machines, Numerical problems using shortest processing time (SPT) rule, earliest due date (EDD) rule.	**07**
UNIT-04	**Quality Control and Assurance:** Quality and its evolution, Dimensions of Quality, Quality Control and its Impact, Introduction to SQC, Japanese Contribution to Quality Control, Managing Quality, Concept of Six Sigma, ISO 9000 and 14000 standards, Quality Assurance, Inspection and control of quality, control charts: x-chart and R-chart, p-chart and c-chart, Acceptance sampling- Operating characteristic (O.C) curve, Specific Case Studies	**07**

UNIT-05	**Work Study:** Method Study: Introduction of method study and the selection of jobs, Work Measurement: Introduction, Work sampling, Time Study, equipment, timing the job, rating, Calculation of standard time, setting time standard for works and machines, Methods Study-Techniques of Analysis, recording, Work Measurement and Time Study, Predetermined Motion Time Standards and Work Sampling, Standard Time Estimation, Predetermined time standards, Specific case studies.	**07**

Course Outcomes

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

CO1: Understand the concept of operations and production management.

CO2: Able to apply the theory to practice numerical problems on scheduling and sequencing jobs.

CO3: Identify the problems associated with production systems.

CO4: Design and conduct time study and work study in organisation.

Recommended Books

1. Production and Operations Management by Ramamurthy, New Age International
2. Production and Operations Management Concept, Models by Adam and Ebert, Prentice Hall of India
3. Modern Production/Operations Management by Buffa and Sarin, John Wiley &Sons
4. Production and Operations Managementby Jocobs, Tata McGraw Hill
5. Motion and Time Study by Barnes M R, John Wiley, and Sons