

# BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA PLASTIC ENGINEERING

<u>5<sup>th</sup> SEMESTER</u>				<u>6<sup>th</sup> SEMESTER</u>			
<i>THEORY</i>		<i>Contact Hours</i>		<i>THEORY</i>		<i>Contact Hours</i>	
<i>Code</i>	<i>Subject</i>	<i>L-T-P</i>	<i>Credits</i>	<i>Code</i>	<i>Subject</i>	<i>L-T-P</i>	<i>Credits</i>
HSSM3301	Principles of Management	3-0-0		HSSM3302	Optimization Engineering	3-0-0	
Or	or		3	or	or		3
HSSM3302	Optimization Engineering	3-0-0		HSSM3301	Principles of Management	3-0-0	
PCPL4301	Plastic Processing Technology	3-1-0	4	PCPL4304	Advanced Plastics Processing Techniques	3-1-0	4
PCPL4302	Plastics Testing Technique	3-1-0	4	PCPL4303	Mould Engineering	3-0-0	3
HSSM3303	Environmental Engineering and Safety	3-0-0	3	<b>Professional Elective – II (Any One)</b>		3-0-0	3
	<b>Professional Elective – I (Any One)</b>	3-0-0	3	PEPL5304	Material Engineering	3-0-0	3
PEPL5301	CAD/CAM/CAE for Plastic Engineering			PEPL5305	Polymerization Engineering		
PEPL5302	Fundamentals of Plastic Mould & Die Designing.			PEPL5306	Polymer Reaction Engineering		
PEPL5303	Plastic Product Design.			<b>Professional Elective – III (Any One)</b>		3-0-0	3
	<b>Free Elective – I (Any One)</b>	3-0-0	3	PEPL5307	Mass Transfer		
PCME4304	Machining Science & Technology			PEPL5308	Strength of Material		
PECH5303	Fuel & Energy Technology			PEPL5309	Industrial Process Control & Dynamics.		
PEEL5302	Renewable Energy System			PEPL5310	Statistical Quality Control Technique		
	<b>Free Elective – II (Any One)</b>	3-0-0	3	<b>Free Elective – II (Any One)</b>		3-0-0	3
				PEME5309	Non Conventional Energy Sources		
				PCME4305	Heat Transfer		
				PEME5306	Modern Manufacturing Process		
			<b>Credits (Theory)</b>				<b>Credits (Theory)</b>
			<b>20</b>				<b>19</b>
<b>PRACTICALS/SESSIONALS</b>				<b>PRACTICALS/SESSIONALS</b>			
PCPL7301	Plastics Processing Lab.-I .	0-0-3	2	PCPL7303	Plastics Processing Lab.-II .	0-0-3	2
PCPL7302	Plastics Testing Lab.-I	0-0-3	2	PCPL7304	Plastics Testing Lab.-II	0-0-3	2
PCPL7306	Mould Engineering Lab	0-0-3	2	PCPL7305	Design & Mold flow Analysis Practice Using CAD/CAM/ CAE	0-0-3	2
			<b>Credits (Practicals / Sessionals)</b>				<b>Credits (Practicals/Sessionals)</b>
			<b>6</b>				<b>6</b>
<b>TOTAL SEMESTER CREDITS</b>			<b>26</b>	<b>TOTAL SEMESTER CREDITS</b>			<b>25</b>
<b>TOTAL CUMULATIVE CREDITS</b>				<b>TOTAL CUMULATIVE CREDITS</b>			

# HSSM3301 **PRINCIPLES OF MANAGEMENT** (3-0-0)

## **Module I: Functions of Management**

Concept of Management, Management as an Art or Science, The Process of Management, Managerial Skills, Good Managers are Born, not Made, Management is concerned with Ideas, Things and People, How a Manager Induces Workers to Put in Their Best, Levels and Types of Management, **Evolution of Management Thought:** Managerial Environment, The process of Management-Planning, Organizing, Directing, Staffing, Controlling.

## **Module II: Marketing Function of Management.**

Modern Concept of Marketing, The Functional Classification of Marketing, Functions of a Marketing Management, Marketing Mix, Fundamental Needs of Customers, The Role of Distribution channels in Marketing, Advertising, Marketing, Consumerism and Environmentalism.

## **Module III: Financial Function & HRM Functions.**

Financial Functions, Concept of Financial Management, Project Appraisal, Tools of Financial decisions making, Overview of Working Capital.

**HRM Function of Management:** Human Resource Management, Human Resource Development, Importance of HRM, Overview of Job Analysis, Job Description, Job Specification, Labour Turnover. Manpower Planning, Recruitment, Selection, Induction, Training and Development, Placement, Wage and Salary Administration, Performance Appraisal, Grievance Handling, Welfare Aspects.

## **Reference Books:**

1. *Business Organization & Management*, CR Basu, TMH
2. *Business Organization & Management*, Tulsia, Pandey, Pearson
3. *Marketing Management*, Kotler, Keller, Koshi, Jha, Pearson
4. *Financial Management*, I.M. Pandey, Vikas
5. *Human Resource Management*, Aswasthapa, TMH.
1. *Modern Business Organisation & Management* by Sherlekar, Himalaya Publishing House.

# HSSM3302 **OPTIMIZATION IN ENGINEERING** (3-0-0)

## **Module-I (10 Hours)**

Idea of Engineering optimization problems, Classification of optimization algorithms, Modeling of problems and principle of modeling.

**Linear programming:** Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method, Sensitivity analysis in linear programming

## **Module-II (10 Hours)**

**Transportation problems:** Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method

**Assignment problems:** Hungarian method for solution of Assignment problems

**Integer Programming:** Branch and Bound algorithm for solution of integer Programming Problems

**Queuing models:** General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, Multiple server, Finite sources, Queue discipline.

## **Module-III (10 Hours)**

**Non-linear programming:** Introduction to non-linear programming.

**Unconstrained optimization:** Fibonacci and Golden Section Search method.

**Constrained optimization with equality constraint:** Lagrange multiplier, Projected gradient method

**Constrained optimization with inequality constraint:** Kuhn-Tucker condition, Quadratic programming

Introduction to Genetic Algorithm.

### **Recommended text books**

1. A. Ravindran, D. T. Philips, J. Solberg, “ *Operations Research- Principle and Practice*”, Second edition, Wiley India Pvt Ltd
2. Kalyanmoy Deb, “ *Optimization for Engineering Design*”, PHI Learning Pvt Ltd

### **Recommended Reference books:**

1. Stephen G. Nash, A. Sofer, “ *Linear and Non-linear Programming*”, McGraw Hill
2. A.Ravindran, K.M.Ragsdell, G.V.Reklaitis,” *Engineering Optimization*”, Second edition, Wiley India Pvt. Ltd
3. H.A.Taha,A.M.Natarajan, P.Balasubramanie, A.Tamilarasi, “*Operations Research*”, Eighth Edition, Pearson Education
4. F.S.Hiller, G.J.Lieberman, “ *Operations Research*”, Eighth Edition, Tata McDraw Hill
5. P.K.Gupta, D.S.Hira, “*Operations Research*”, S.Chand and Company Ltd.

## PCPL4301 **PLASTICS PROCESSING TECHNOLOGY** (3-1-0)

### **Module –I Injection moulding, Compression moulding & Transfer moulding (18 hr)**

Injection moulding -Principles processing- Process variables - Mould cycle – Moulding Machine–Specifications - Construction and maintenance –Mould setup- process trouble shooting.

Compression moulding- principles - Bulk factor and flow properties moulding materials- Process variables-Curing time- Mould temperature and Pressure requirements- preforms and preheating- common moulding faults and their correction-Finishing of moulded product.

Fundamental principles of transfer moulding-advantages over compression moulding- Equipment used- pressures requirements -Line pressures- Injection ram pressure-clamping-Heating requirements-Moulding faults - causes and remedies.

### **Module – II Extrusion, Blow moulding, Thermoforming (15 hr)**

Basic principles of extrusion – Types of extruders, extruder parts- polymer flow mechanism, die entry effects and exit instabilities-melt fracture & Bambooning. Factors affecting the output of an extruder, process variables in extrusion- downstream equipments for the production of films, blown film, cast film/slot film, BO film, co extruded film. Tube/pipe-sizing take off equipment, extrusion coating, wire & cable covering

Injection and extrusion blow moulding processes, accumulation blow moulding-processing parameters- materials requirements -blow moulding machine features and operation -faults, causes and remedies-parison programming, blow moulding of difficult articles like fuel tanks, odd shaped containers with handles, limitation in blow moulding, Basic principles and types of thermoforming processes, Thermoforming moulds-processing parameters—faults, causes and remedies.

### **Module – III Calendaring, Rotational molding and FRP & Laminates (12 hr)**

Calendaring - principle and process description- types of calendar units -design of calendar roll, Heating and temp control, roll crown, roll crossing and roll bending - calendaring sheets and films, embossing, coating and lamination by calendar, comparison between calendaring and extrusion.

Introduction-principle-process-machinery used-materials-moulds process parameters- merits & demerits of rotomolding.

Introduction, FRP Processing methods- hand lay up-spray up -vacuum bag & pressure bag moulding, filament welding – pultrusion – pulforming- matched die moulding

#### **Text Book**

1. Injection Molding Theory & Practice , Irvin I. Rubin, Wiley-Interscience (1973)
2. Injection Molding Hand Book Third Ed., D.V Rosato, D.V. Rosato & M.G. Rosato, Kluwer academic publishers (2000)
3. Plastics: Material & Processing, A. Brent Strong, Third Ed., Prentice Hall (2005)

#### **Reference Book:**

1. A Guide to Injection Molding of Plastics, P.C. Bolur, allied Publishers (2000)
2. Development in Injection Molding, Ed. Whelan, Elsevier (1985)
3. Plastics Materials & Processing – S.S.Schwartz and S.H.Goodman, Nostrand Reinhold (1982)
4. Injection Molding, A.S. Athalye, second Ed. (1997).
5. INJECTION MOULDING OF PLASTICS:A USER GUIDE Klockner Winsor India Ltd (1994)
6. Innovation in Polymer Processing - By Stevenson
7. Extrusion The definitive Processing Guide and Hand Book - By Giles, H.H & Others
8. Compression Molding - By Iyeseu, A.I
9. Polymer Extrusion - By Rauwedaal, Chris
10. Thermoforming - By James & Throne
11. Basic Principle of rotational molding - By Crawford, R.J & Throne, J.L

12. Basic Principle of Rotational Molding - By Bruins
13. Basic Principle of Thermoforming - By Bryce, D.M
14. Plastics Injection Molding - By Bryce, D.M
15. Injection molding of Plastics component - By Bown John
16. Plastics Mold Design Vol.1 Compression & Transfer Moulds - By Bebb
17. Plastics forming - By Beadle
18. Calendering of Plastics - By Elden & Swan

## PCPL4302 **PLASTICS TESTING TECHNIQUES** (3-1-0)

### **Module – I Standards, specifications and testing** **(18 hr)**

Standard and specification-National and International standards-Test specimen preparation-preconditioning and test atmosphere.

**Mechanical Properties:** Hardness-tensile strength-compressive strength-shear strength-flexural strength-heat strength-impact strength-dynamic stress-strain properties-creep-relaxation and set tests-friction and wear-abrasion test-fatigue-burst strength-and folding endurance.

**Thermal Properties:** Specific heat and thermal conductivity thermal dependant properties-thermal endurance-glass transition temperature-thermal yield tests-Heat deflection temperature- Vicat softening temperature- Marten's heat resistance test-low temperature brittle point and flexibility test-coefficient of thermal expansion-shrinkage-Thermal stability-Thermal ageing and flammability.

### **Module – II Optical and electrical properties** **(15 hr)**

Optical Properties -Refractive index-light transmission-haze-clarity-gloss-colour guard and microscope. Electrical Properties-Insulation resistance-power factor-permittivity – dielectric strength-tracking resistance-arc resistance and antistatic test.

**Permeation properties:** Water absorption-soluble and insoluble matter-chemical resistance environmental stress cracking resistance-ageing-gas permeability-water vapour permeability and weathering

Knowledge and exposure on Sectorial Testing Standards

**Preconditioning and test atmosphere** - Testing of Mechanical, Thermal, Optical, Electrical properties, Permeability Properties and Rheological properties.

### **Module – III Product testing** **(12 hr)**

Pipe and fittings-film and sheets-container testing and FRP based products.

Factors for designing tests for newer products- Factors affecting the quality of materials and products- analysis of failure and its measurements

**Techniques of characterization**-Principles and application of DSC- TGA AND FTIR, Concepts of non-destructive testing

#### **Text Books**

1. Hand Book of Plastics Testing Technology, Shah, Vishnu, John Wiley and Sons, SPE Monograph (1984)
2. Hand Book of Polymer Testing, Brown; Roger P (Ed.), Marcel Dekker, Inc, New York (1999)
3. Hand Book of Plastics Technology 2 vol. By Allen, W.S & Baker P.N

#### **Reference Books**

1. Plastic Engineering Hand Book & D-5 By Society of Plastics Industry Inc
2. Brown; Paul F (Ed), Hand Book of Plastics Test Methods, Longman Scientific and Technical, Harlow88
3. Blythe;A. R, Electrical Properties of Polymers, Cambridge University Press, Cambridge (1979).
4. Electrical Properties of Polymers, Blythe;Tony and Bloor; David, 2<sup>nd</sup> Ed, Cambridge Press
5. Plastic Engineering Hand Book & D-5 By Society of Plastics Industry Inc
6. Mitcheli Jr.; John, Applied Polymer Analysis and Characterization-Recent Development in Techniques, Instrumentation, Problem Solving, Hanser Publishers

# HSSM3303 **ENVIRONMENTAL ENGINEERING & SAFETY**

(3-0-0)

## **Module – I**

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution- Noise standards, measurement and control. Water Treatment: water quality standards and parameters, Ground water. Water treatment processes, Pre-treatment of water, Conventional process, Advanced water treatment process.

## **Module – II**

(a)Waste Water Treatment: DO and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production.

(b)Air Pollution : Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –greenhouse gases, non-criteria pollutants, air pollution meteorology, Atmospheric dispersion. Industrial Air Emission Control. Flue gas desulphurization, NOx removal, Fugitive emissions.

(c) Solid waste, Hazardous waste management, Solid Waste Management, Source classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques. Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A., Environmental auditing,

## **Module – III**

Occupational Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error and Hazard Analysis. Hazard Control Measures in integrated steel industry, Petroleum Refinery, L.P.G. Bottling, Pharmaceutical industry. Fire Prevention – Detection, Extinguishing Fire, Electrical Safety, Product Safety. Safety Management- Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Gas Cylinders, Hydro Carbons and Wastes. Personal Protective Equipments.

## **Text Book :**

1. Environmental Engineering Irwin/ McGraw Hill International Edition, 1997, G. Kiely,
2. Environmental Engineering by Prof B.K. Mohapatra, Dhanpat Rai & Co Publication
3. Industrial Safety Management, L. M. Deshmukh, Tata McGraw Hill Publication.

## **Reference Books**

1. Environmental Engineering by Arcadio P. Sincero & Gergoria A. Sincero PHI Publication
2. Principles of Environmental Engineering and Science, M. L. Davis and S. J. Masen, McGraw Hill International Edition, 2004
3. Environmental Science, Curringham & Saigo, TMH,
4. Man and Environment by Dash & Mishra
5. An Introduction to Environmental Engineering and Science by Gilbert M. Masters & Wendell P. Ela - PHI Publication.
6. Industrial Safety Management and Technology, Colling. D A – Prentice Hall, New Delhi.

# PEPL5301 CAD/CAM/CAE FOR PLASTICS ENGINEERING

## **Module I Computer Aided Designing Fundamentals (12 hours)**

Output primitives (points, lines, curves, etc.) 2-D Transformation, Translation, Scaling, Rotation, windowing, View ports clipping transformation.

Interactive CAD programs AutoCAD, Auto LISP/C/C++, creation of surface, solids etc., using solid modeling package (prismatic and revolved parts), Data exchange, customizing- Representation of curves –surface modeling technique – surface patch – Bezier and B-spline surfaces – Volume modeling – Boundary models – CSG other modeling techniques- surface editing- Data Exchange and communication standards- 2D Representation –Integration of design analysis and CAD- mesh generation techniques – post processing – 3D Model generation.

## **Module II Computer Aided Manufacturing (12 hour)**

Introduction to CAM software packages, Automation strategies in production process – G - Codes & M – Codes - NC system –part programming – APT language – DNC-CNC and Adaptive Control- Accuracy, repeatability, End efficacy, sensors, control systems & type of programming, post processing.

control systems – Linear Feed back Steady state optimal control, Adaptive Control, Manufacturing methods for fabrication of moulds & dies- Design FMS workstations – analysis methods – automated Materials Handling – Types –Computer Integrated Production Planning System – Computer Processes interface – Process Monitoring – Supervisory Computer Control – Computer Monitoring – Types & Strategies.

## **Module III Computer Aided Engineering (11 hour)**

Computer modeling for polymer processing: Models of Material Behavior, Model simplifications, Finite difference, Finite element techniques for field problems, Simulation of viscoelastic fluid flow, computer implementation of Process models. Advanced computational techniques, Supercomputing and Visualization of Results.

Concept of A.I. and knowledge based systems in selection and processing of polymers. CAE in Mould Manufacture: Computerized numerical control. Flexible manufacturing.

**Total Lectures = 35**

### **Reference Books**

1. Computer Integrated Manufacturing Paul G. Ranky (Prentice Hall, 1990.)
2. CAD/CAM/CIM Radhakrishnan, P. & Subramanyan. S. (Wiley Eastern Ltd., 1994.)
3. An Introduction to Automated Process Planning Chang. T.C. & Wysk (Prentice Hall Inc., Englewood Cliffs - New Jersey.)
4. Computer Integrated Manufacturing Systems Yoram Koren (McGraw Hill, 1983.)
5. Automation, Production and Systems and Computer - Integrated Manufacturing Mikell P. Groover,(Prentice Hall of India Pvt. Ltd., 1998.)
6. Computer Graphics- Donald Hearn and M.Pauline Baker (*Prentice Hall, Inc., 1992*)
7. CAD/CAM principles, practice and manufacturing management - By Chris McMohan and Jimmi (Browne Pearson Education Asia,Ltd.,2000)
8. Braun; Dietrich, Cherdron; Harald and Ritter; Helmut, Polymer Synthesis: Theory and Practice-Fundamentals, Methods, Experiments, 3<sup>rd</sup> Edition, Springer Verlag, Berlin (2001).

# PEPL5302 **FUNDAMENTALS OF PLASTICS MOULD / DIE**

## **DESIGN (3-0-0)**

### **Module I Product Design**

**(12 hour)**

Orthographic projection-Projection of solids—vertical and horizontal surfaces-Inclined Surfaces-Curved Surfaces-Sectional views and assembly drawing.

Basic Principles-Shrinkage-Flash lines-Undercuts-suggested Wall thickness-Draft-Tolerance-Moulded holes-threads-radius- moulded hinges-integral hinge-snap fits - product design thumb rules - case studies and product design.

### **Module II Mould Design**

**(12 hour)**

Parting line-Construction of core and cavity-types of gate-types of ejection-Mould temperature control - cooling - Mould alignment Mould ancillary parts.

Types of moulds-two plate - three plate - split moulds - Machine selection-Principles of shrinkage allowances-materials for mould parts-life of mould-mould maintenance-case studies on mould design. Injection Moulds for threaded components – automatic unscrewing – various unscrewing methods

### **Module III Screw Design**

**(11 hour)**

Extrusion die design—Construction features of an extruder, Process, Characteristics of Polymer melt, Die geometry, Die head Pressure, characteristics of land length to Profile thickness, Extrudate die swell, Die materials, Classification of dies-Dies for Solid Section, Dies for Hollow Profiles, Blown film dies, Flat film dies, Parison dies, Wire and cable Coating dies, Spiral mandrel die, Fish tail die, Adjustable Core die

**Total Lectures = 35**

### **Text Books**

1. Injection Mould Design for Thermoplastic - By Pye, R.G.W
2. Injection Mould & Molding - By Dym
3. Injection Moulds – 130 Proven Design - By Gastrow, H
4. Plastics Product Design Engineering Hand Book - By Dubois, H
5. Plastics Product Design & Process Engineering - By Belofsky, Harold
6. Laszlo Sors and Imre Balazs, "Design of Plastics Moulds and Dies", Elsevier, Amsterdam - Oxford – Tokyo - NY, 1989.

### **Reference Books**

1. Plastic Design & Processing - By Sharma, S.C
2. Plastics Moulds & Dies - By Sors, & Others
3. Injection Mould Design Fundamentals (Vol. I& II) - By Glanvill & Denton

# PEPL5303 **PLASTICS PRODUCT DESIGN** (3-0-0)

## **Module I Product Design**

**(12 hour)**

Concepts - size, shape and function - form and function - Aesthetics, Ergonomics - shrinkage, Flash lines. Undercuts - External & Internal - Wall thickness - variances in wall thickness - emphasize on designing with engineering plastics. Taper or draft. Fits & Tolerances. Designing with plastics for load bearing applications like gears, bearing, sandwich laminates. Design of radii, fillets, ribs and bosses

## **Module II Moulded threads—thread pieces—threaded holes**

**(12 hour)**

Moulded Holes - through holes - blind holes - threaded holes - side holes - holes parallel to draw - nearness of holes to each other and side wall - moulding holes not parallel to draw - drilled and tapped holes. Design of integral hinges, snap fits- Inserts-Materials- Selection of metal for inserts-minimum wall thickness of material around inserts-anchorage-relieving moulding stresses around inserts-location of inserts in the part-moulded in inserts-pressed in inserts

Quality and economy-tooling aspects on product design-process variables vs product design-product design appraisal..Prototype development – rapid prototyping techniques – stereo lithography.

## **Module III Composite product design**

**(11**

**hour)**

Concepts of composite product design-Design requirements-functional-safety-reliability –cost effectiveness

Design constraints- factor of safety -design failure criteria- design optimization.

Design data-physical, mechanical and functional properties of composites-code of practice of loading on structures-structure properties relation of composites-failure criteria and design.

Design of simple structural elements-tension bars-columns-beams-pipes-plates and shells.

Design of joints-bolted joints and bonded joints

**Total Lectures = 35**

## **Text Books**

1. Plastics Product Design Engineering Hand Book- By Dubois, H
2. Belofsky, H., "Plastics Product Design and Processing Engineering, Hanser Publishers, Munich Vienna New York, 1994.

## **Reference Books**

1. Robert A. Malloy, "Plastic Part Design for Injection Moulding", Hanser Publishers, Munich Vienna, New York, 1994.
2. Paul A. Tres, "Designing Plastic Parts for Assembly", 2<sup>nd</sup> Revised Edition, Hanser Publishers, Munich Vienna New York, 1994.
3. N G Mc Crum, Principles of Polymer Engineering, Oxford Science Publications, New York, 1997

# PCME4304 **MACHINING SCIENCE & TECHNOLOGY** (3-0-0)

## **Module – I**

**(13 hours)**

Geometry of cutting tools in ASA and ORS, Effect of Geometrical parameters on cutting force and surface finish, Mechanics of chip formation, Merchant's theory, Force relationship and velocity relationship, Cutting tool materials, Types of Tool Wear: Flank wear, Crater wear, Wear measurement, Cutting fluid and its effect; Machinability Criteria, Tool life and Taylor's equation, Effect of variables on tool life and surface finish, Measurement of cutting force, Lathe tool dynamometer, Drill tool dynamometer. Economics of machining.

## **Module – II**

**(13 hours)**

Conventional machining process and machine tools – Turning, Drilling, Shaping, Planning, Milling, Grinding. Machine tools used for these processes, their specifications and various techniques used.

Principles of machine tools : Kinematics of machine tools, speed transmission from motor to spindle , speed reversal mechanism, mechanism for feed motion, Tool holding and job holding methods in different Machine tools, Types of surface generated, Indexing mechanism and thread cutting mechanism, Quick return mechanism,.

Production Machine tools – Capstan and turret lathes, single spindle and multi spindle semiautomatics, Gear shaper and Gear hobbing machines, Copying lathe and transfer machine

## **Module – III**

**(10 hours)**

Non-traditional Machining processes :

Ultrasonic Machining, Laser Beam Machining, Plasma Arc Machining, Electro Chemical Machining, Electro Discharge Machining, Wire EDM , Abrasive Jet Machining

### **Text Books :**

1. Fundamentals of Machining and Machine Tools, G.Boothroyd and W.A.Knight, CRC Press
2. Metal Cutting Principles, M.C.Shaw, Oxford University Press
3. Metal Cutting Theory and Practice, A.Bhattacharya, Central Book Publishers

### **Reference Books :**

1. Manufacturing Technology – by P.N.Rao, Tata McGraw Hill publication.
2. Modern Manufacturing Processes, P.C.Pandey, H.S.Shan, Tata McGraw Hill
3. Manufacturing Science, Ghosh and Mallik, East West Press.
4. Metal Cutting Theory and Practice, D.A.Stephenson and J.S.Agapiou, CRC Press
5. Machining Technology; Machine Tools and Operation, H.A.Youssef and H. El-Hofy, CRC Press
6. Machine Tools and Manufacturing Technology, Krar, Rapisarda and Check, Cengage Learning
7. Technology of Machine Tools, Krar, Gill and Smidt, Tata McGraw Hill
8. Principles of Metal Cutting, G.Kuppuswamy, Universities Press
9. Metal Cutting and Machine Tools, G.T.Reddy, Scitech
10. Fundamentals of tool Engineering Design, S.K.Basu, S.K.Mukherjee, R. Mishra , Oxford & IBH Pub Co.
11. Machine Tools, R.N.Datta, New Central Book Agency

# PECH5303 **FUEL AND ENERGY TECHNOLOGY** (3-0-0)

## **Module - I**

Fuels : Solid Fuels : Coal - Origin, Chemical composition, calorific value, Classifications, Characteristics & distribution of Indian coals, Storage and spontaneous combustion of coal, Coal washing and blending, Petrographic constituents of coal, Carbonization of coal, manufacture and properties of metallurgical coke, recovery of by-products.

## **Module - II**

Liquid Fuels : Origin and composition of crude oil, crude oil distillation and its products with special reference to gasoline, Kerosene and diesel oil, cracking and reforming, Coaltar distillation Products, Shale oil. Gaseous Fuels : Natural gas, coal gas. Coke oven and blast furnace gas, Manufacture of Water gas and producer gas, Carburetted water gas.

## **Module - III**

Synthetic Fuels : Hydrogenation of coal, Fischer – Tropsch synthesis, Introduction. Nuclear fuels and nuclear reactors, moderators and structural materials. Combustion : Combustion of solids fuels, Pulverized coal. Calculation of volumes and weights of air necessary for combustion of fuels, gas analysis.

## **Books :**

1. Fuels and Combustion - S. Sarkar
2. Elements of Fuel Technology - Himus
3. Solid, Liquid and gaseous fuel - Brame and King.
4. Elements of Fuels, Furnaces and Refractories, O. P. Gupta.

# PEEL5302 RENEWABLE ENERGY SYSTEMS

## **Module I (5 Hours)**

### **Introduction**

Fossil fuel based systems Impact of fossil fuel based systems, Non conventional energy – seasonal variations and availability, Renewable energy – sources and features, Hybrid energy systems, Distributed energy systems and dispersed generation (DG)

## **Module II: (20 Hours)**

### **Solar Photovoltaic systems:**

Operating principle, Photovoltaic cell concepts, Cell, module, array, Series and parallel connections, Maximum power point tracking, Applications, Battery charging, Pumping, Lighting, Peltier cooling

Solar processes and spectral composition of solar radiation; Radiation flux at the Earth's surface. Solar collectors. Types and performance characteristics. Applications

### **Wind Energy:**

Wind energy conversion; efficiency limit for wind energy conversion, types of converters, aerodynamics of wind rotors, power ~ speed and torque ~ speed characteristics of wind turbines, wind turbine control systems; conversion to electrical power: induction and synchronous generators, grid connected and self excited induction generator operation, constant voltage and constant frequency generation with power electronic control, single and double output systems, reactive power compensation; Characteristics of wind power plant. Applications:

## **Module III (15 hours)**

### **Biomass Power:**

Operating principle, Combustion and fermentation, Anaerobic digester. Wood gassifier, Pyrolysis, Applications, Bio gas, Wood stoves, Bio diesel, Combustion engine.

Application,

### **Hybrid Systems**

Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles

### **Text Books:**

1. D. P. Kothari, K. C. Singal, R. Ranjan, *Renewable Energy Sources and Emerging Technologies*, Prentice Hall of India, New Delhi, 2008.
2. B.H.Khan, *Non-Conventional Energy Resources*, Tata McGrawHill, 2009
3. S. N. Bhadra, D. Kasta, S. Banerjee, *Wind Electrical Systems*, Oxford Univ. Press, New Delhi, 2005.

### **Reference Books:**

1. S. A. Abbasi, N. Abbasi, *Renewable Energy Sources and Their Environmental Impact*, Prentice Hall of India, New Delhi, 2006.

## PCPL7301 **PLASTICS PROCESSING LAB – I** (0-0-3)

Sl. No.	Name of M/c/ Equipment/Mould	Description of Practical Exercise to be done
1.	Hand operated Injection Moulding Machine	(i) Study of Machine in Idle-Run Observation (IRO), Parts & functions, operating principle, Free sketch of Machine-parts (ii) Operation practice to produce moulding on different hand injection moulds.
2.	Injection Moulding Semi Automatic	(i) Study of Machine of all types in IRO. Comparative study of Pneumatic type & Hydraulic type of Machine, Operating Principle - Line-diagrams and specifications. (ii) Operation practice of Pneumatic & Hydraulic types- Cycle-time analysis, observations of Process-Parameters
3.	Extrusion Processes on Extruders	(i) Study of Extruders in IRO, Free sketch of machines, their parts and parts-function, List of products manufactured by Extrusion-Process. Study of different types of extrusion process. (ii) Operation-Practice by Trainee on setting up of Process-parameter to produce Blown-Film on Film-plant, observations on extruder output, size of film produced and technical specifications of machines to be recorded.
4.	Compression moulding - Hand Operated	(i) Study of machine IRO Free sketch of parts & study of part-function, comparison of Compression and injection moulding processes. (ii) Operating Principle of Hand Compression Press, mould setting-procedure & parameter setting, operation practice on different compression moulds, machine specification
5.	Blow Moulding Hand Operated	(i) Study of Hand Blow Moulding machine, Free-sketch of machine parts & study of part-function, machine specification (ii) Die-centering practice by Trainees, operation of Hand Blow Machines, to produce components observations, cycle-time analysis Procedure of operation and observations.
6.	Scrap Grinding	(i) Machine Study in IRO, specification, study of parts & function, Line Diagram (ii) Operation-practice with different materials and output study in Kg/hour for different materials.
7.	Injection Moulding machine Automatic	Study of machine Parts & function- clamping systems- Technical specification of Machine, study of process sequence in Machine, Study & definitions- Definitions of all Processing Parameters & controls.
9.	Blow-Moulding Semi Automatic	Technical specification - Mould clamping -, operation practice with different moulds, Familiarization with control-switches/ valves cycle-time analysis & procedure of

- 10      Introduction to maintenance      operation.  
Basic knowledge of Hydraulic & Pneumatic systems, Electrical system, Definition of terms- Hydraulic fluid, viscosity Directional Valves, Resistance, Current, Voltage, Power, Hydraulic Pumps - Types & function, electrical heaters, thermocouples and temperature control parameters and timers, electrical Motors -Types & function.

## PCPL7302 **PLASTICS TESTING LAB -I** (0-0-3)

Sl. No.	Experiment/Exercise
1	Determination of Melt flow index of plastics materials
2	Study of Mechanical properties of plastics & test methods
3	Study of Weathering properties.
4	Determination of Burst strength & tear strength of films
5	Determination of Hardness (Rockwell, shore A & shore D, Barcol
6	Specimen preparation by Injection moulding, contour cutting, compression moulding, contour punching, etc.
7	Testing of Electrical and Optical properties of Plastics materials
8	Introduction to product testing

## PCPL7306 **MOULD ENGINEERING LAB** (0-0-3)

### **Experiments**

1. Study of different types of Cutting tools.
  2. Measurements using Micrometer, vernier, Height gauge and Slip gauge.
  3. Measurement of angles and tapers.
  4. Checking of straightness using auto collimeter.
  5. Application of Dial gauge.
  6. Pantograph milling and Drilling M/c, EDM, Wire cut
  7. Study and Detailing of mould assembly
  8. Gas assisted and Water assisted Injection mould and Hot runner mould
  9. Hand compression mould design – positive, semi positive, displacement type mould, and design with split cavities
  10. Transfer mould design (pot type & top plunger type)
  11. Automatic unscrewing mould
  12. Design of Rotational & Thermoforming Mould
  13. Mould design for industrial component
- (Any 8 experiments from the above)**

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