## BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA
### PRODUCTION ENGINEERING

<table>
<thead>
<tr>
<th>5th SEMESTER</th>
<th>6th SEMESTER</th>
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<tbody>
<tr>
<td><strong>Theory</strong></td>
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<tr>
<td>HSSM 3302 Optimization Engineering</td>
<td>PCME 4404 Production and Operation Management</td>
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<td>HSSM 3303 Environmental Engineering and Safety</td>
<td>PCMF 4302 Tool Design</td>
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<tr>
<td>PCME 4303 Design of Machine Elements</td>
<td>PCME 5306 CAD/CAM</td>
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<td>PCPR 4301 Principle of Machine Tools</td>
<td>PCMF 4301 Materials Deformation Process</td>
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<td>Professional Elective - I (Any one)</td>
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<tr>
<td>PEMF 5302 Advanced Casting and Welding</td>
<td>FEME 6301 Finite Element Methods</td>
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<td>PCMF 5304 Tool Design Sessional</td>
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<td>PEIT 5301 E Commerce</td>
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<tr>
<td>PEMF 5303 Maintenance Engineering and Management</td>
<td>PETX 5412 Management Information System</td>
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<td>PCMF 5302 Manufacturing Lab-3(Machine Shop)</td>
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<tr>
<td>PEME 5303 Rapid Prototyping</td>
<td>PEME 5305 Robotics and Robotics Application</td>
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<td>PEME 5304 Tribology</td>
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<td>FEME 6302 Project Management</td>
<td>PEME 5308 Non Conventional Energy Sources</td>
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<td>BECS 2212 C++ and Object Oriented Programming</td>
<td>PEME 6303 Heat Power Engineering</td>
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<td>PEME 5408 Composite Material</td>
<td>PEME 5308 Non Conventional Energy Sources</td>
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<td>BECS 2212 C++ and Object Oriented Programming</td>
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<td>Credits (Theory) 18</td>
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### PRACTICALS/SESSIONALS

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<tr>
<th>5th SEMESTER</th>
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<tr>
<td>PCMF 7305 Metallurgy and NDT Lab</td>
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<td>PCPR 7301 NTM Lab</td>
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<td>PCMF 7301 Manufacturing Lab-4</td>
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<td>Credits (Practicals / Sessionals) 6</td>
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TOTAL SEMESTER CREDITS 24  TOTAL SEMESTER CREDITS 24
TOTAL CUMULATIVE CREDITS 133  TOTAL CUMULATIVE CREDITS 157
HSSM3302 OPTIMIZATION ENGINEERING     (3-0-0)

Module-I
(10 Hours)

Module-II
(10 Hours)

Module-III
(10 Hours)

Recommended text books

Recommended Reference
HSSM3303 ENVIRONMENTAL ENGINEERING & SAFETY (3-0-0)

Module - I

Module - II:
(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. 


Text Book:
2. Environmental Engineering by Prof B.K. Mohapatra, Dhanpat Rai & Co Publication

Reference Books
1. Environmental Engineering by Arcadio P. Sincero & Gergoria A. Sincero PHI Publication
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
PCME4303 DESIGN OF MACHINE ELEMENTS (3-1-0)

Module-I (12 hours)
Design of Joints: Riveted joints, Boiler joints, Welded and bolted joints based on different types of loading. Illustrative problems with solutions.

Module-II (14 hours)
Design of Cotter joints with socket and spigot, with a Gib. Design of knuckle joint. Illustrative problems with solutions.
Design of shafts, solid and hollow based on strength and on rigidity. Illustrative problems with solutions.
Design of keys and pins, Suck key, Feather key, Taper pin. Illustrative problems with solutions.
Design of shaft couplings: Rigid Flange coupling, Flexible Flange coupling.

Module-III (14 hours)
Design of circular section, Helical springs, Tension and compression types, Design of leaf springs: Cantilever and semi-elliptical types. Illustrative problems with solutions.
Levers, classification, Design of Foot levers, Hand lever, Cranked lever, Lever of lever loaded - safety - valve. Design of belt and pulley Power screw design with square thread, such as screw jack. Illustrative problems with solutions.
[Only specified data book as mentioned in the syllabus is permitted during examination]

TEXT BOOKS:

REFERENCE BOOKS:

DESIGN DATA HAND BOOKS:
1. P.S.G.Design Data Hand Book, PSG College of Tech Coimbatore
PRINCIPLE OF MACHINE TOOLS

Module-1          14 Hrs

conventional machining process and machine tools-Turning, Drilling, Shaping, Planning, Milling, Grinding Machine tools for these processes, their specifications and various techniques used, calculation of cutting time, speed, feed, MRR etc.

Module-2

principle 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.

Module-3

Production Machine tools-Capstan and turret lathes, single spindle and multi spindle semiautomatics, Gear shaper and Gear hopping machines, Coping lathe and transfer machine
PROFESSIONAL ELECTIVE-I
PEMF5302 ADVANCED CASTING & WELDING (3-0-0)

MODULE- I  
(12 hours)
CASTING DESIGN: Solidification of pure metals and alloys-shrinkage in cast metals-design of sprue, runner, gate and risers-problems in design and manufacture of thin and unequal sections designing for directional solidification, minimum distortion and for overall economy -design problems of L, T, V, X and Y junctions.

MODULE II  
(10 hours)
WELD DESIGN AND WELDING METALLURGY: Design of welded components-symbolic representation of welds on drawings- welding classes-residual stresses in welds-weld distortions-design consideration-strength consideration of welded joints-analysis of statistically loaded welded joints-welded structures subjected to fatigue loads.

MODULE III  
(12 hours)
SPECIAL CASTING AND WELDING PROCESSES: Evaporative pattern casting-ceramic mould casting -electro magnetic moulding-squeeze casting -investment casting-shell moulding-PAW-electron beam welding-laser beam welding-friction welding-ultrasonic welding -diffusion welding-high velocity oxy fuel processes
QUALITY CONTROL AND AUTOMATION : Cleaning and inspection of castings - Casting defect and remedies - foundry automations-moulding machines-Automation of sand plant, moulding and fettling sections of foundry-Dust and fume control-Welding defects -causes and remedies - Non Destructive tests - arc welding using robots-weld positioner and manipulators -weld seam tracking-vision system-arc sensing welding

TEXT BOOKS

REFERENCES
4. HEINE, R.W., LOPER.L.R., and ROSENTHAL,C, Principles of Metal Casting, TMH  
5. MINKOFF,.J., solidification and cast structure,wiley.1986  
PEMF5303 MAINTENANCE ENGINEERING & MANAGEMENT (3-0-0)

MODULE- I  
MAINTENANCE CONCEPTS:  
Objectives and functions - Tero technology - Reliability Centered Maintenance (RCM) -  
maintainability prediction - availability and system effectiveness - maintenance costs -  
maintenance organization, Minimal repair - maintenance types - balancing PM and  
breakdown maintenance - PM schedules: deviations on both sides of target values - PM  
schedules: functional characteristics - replacement models

MODULE- II  
TOTAL PRODUCTIVE MAINTENANCE:  Zero breakdowns - Zero Defects and TPM -  
maximizing equipment effectiveness - autonomous maintenance program - five pillars of TPM -  
TPM small group activities - TPM organization - management decision - educational campaign -  
creation of organizations - establishment of basic policies and goals - formation of master plan -  
TPM implementation

MODULE- III  
MAINTENANCE LOGISTICS: Human factors in maintenance - maintenance manuals -  
maintenance staffing methods - queuing applications - simulation - spare parts  
management - maintenance planning and scheduling

DIAGNOSTIC MAINTENANCE: Leak detection - wear monitoring - Temperature monitoring  
Vibration monitoring - Signature analysis - Shock monitoring - Lubricant Analysis - Methodology -  
Equipments - Applications

ONLINE MONITORING: Condition Monitoring Techniques - Vibration Monitoring, Signature  
Analysis - Wear Debris Monitoring - Maintenance Management Information System - Expert  
systems - Corrosion Monitoring and Control

TEXT BOOKS
2. Gopalakrishnan, P. and Banerji, A.K. Maintenance and Spare Parts Management,  

REFERENCES
2. Shirose, K., "Total Productive Maintenance for Workshop Leaders", Productivity  
PEMF5404 RAPID PROTOTYPING (3-0-0) (12 hours)

MODULE - I

LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS: Classification - Liquid based system - Stereo lithography Apparatus (SLA), details of Sl. process, products, Advantages, Limitations, Applications and Uses. Solid based system- Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing.

MODULE - II (11 hours)

MODULE - III (12 hours)
MATERIALS FOR RAPID PROTOTYPING SYSTEMS: Nature of material - type of material - polymers, metals, ceramics and composites liquid based materials, photo polymer development - solid based materials, powder based materials - case study.

REVERSE ENGINEERING AND NEW TECHNOLOGIES: Introduction, measuring device - contact type and non-contact type, CAD model creation from point clouds - pre-processing, point clouds to surface model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, other applications - Case study.

TEXT BOOKS

REFERENCES
FREE ELECTIVES -I

PEME5408 COMPOSITE MATERIALS

Module - I  (14 hours)
1. Introduction:
Classification and characteristics of composite materials, mechanical behaviour of composites, constituents, Reinforcements, Matrices, Fillers, Additives, Applications and advantages of composites.
2. Processing:
Initial form of constituent materials, Manufacturing procedures for fibre-reinforced plastics, quality control.
3. Macromechanical Behaviour:
Stress strain relations of anisotropic materials - Engineering constants for orthotropic materials, Stress strain relations for specially orthotropic lamina. Transformation relationships for a lamina of arbitrary fibre orientation.

Module - II  (12 hours)

Module - III  (10 hours)
FRP Composite Laminate designation and codes, Macromechanical Behaviour of FRP Composite Laminates, Classical Lamination Theory.
General Design Consideration and Suitable laminating Scheme.

Text Book

Reference Book:
3. Composite materials, Broutman & Crock,
FEME6302 PROJECT MANAGEMENT

Module-I


Module-II

Project Planning and Scheduling: Design of project management system; project work system; work breakdown structure, project execution plan, work packaging plan, project procedure manual; project scheduling; bar charts, line of balance (LOB) and Network Techniques (PERT / CPM)/ GERT, Resource allocation, Crashing and Resource Sharing, capacity planning and expansion capacity decision.

Module III

Project Monitoring and Control and Project Performance Planning, Monitoring and Control; Design of monitoring system; Computerized PMIS (Project Management Information System). Coordination; Procedures, Meetings, Control; Scope/Progress control, Performance control, Schedule control, Cost control, Performance Indicators; Project Audit; Project Audit Life Cycle, Responsibilities of Evaluator/ Auditor, Responsibilities of the Project Manager.

Books:

1. Project Planning, Analysis, Selection, Financing, Prasana Chandra, TMH
2. Project Management, Grey, TMH.
3. Project Management, Richman, PHI
4. Project Management, Vasant Desai, HPH
5. Project Management, Bhavesh M.Patel, Vikash
For Admission Batch 2014-15

PEME5304 TRIBOLOGY

MODULE-I  
(12 hours)

Study of various parameters: Viscosity, flow of fluids, viscosity and its variation -absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers used. Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

MODULE-II  
(11 hours)

Hydrodynamic theory of lubrication: Various theories of lubrication, petroff’s equation, Reynolds equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydrodynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti-friction bearing.

MODULE-III  
(12 hours)


TEXT BOOKS:

1. Fundamentals of Tribology, Basu, SenGupta and Ahuja/PHI
2. Tribology in Industry: Sushil Kumar Srivatsava, S. Chand &Co. REFERENCE:
   1. Introduction to Tribology of Bearings - B.C. Majumdar, S. Chand & Co.
For Admission Batch 2014-15

**BECS2212 C++ AND OBJECT ORIENTED PROGRAMMING**

**Module I**

(08 hrs)
Introduction to object oriented programming, user defined types, structures, unions, polymorphism, encapsulation. Getting started with C++ syntax, data-type, variables, strings, functions, default values in functions, recursion, namespaces, operators, flow control, arrays and pointers.

**Module II**

(16 hrs)
Abstraction mechanism: Classes, private, public, constructors, destructors, member data, member functions, inline function, friend functions, static members, and references.
Inheritance: Class hierarchy, derived classes, single inheritance, multiple, multilevel, hybrid inheritance, role of virtual base class, constructor and destructor execution, base initialization using derived class constructors.
Polymorphism: Binding, Static binding, Dynamic binding, Static polymorphism: Function Overloading, Ambiguity in function overloading, Dynamic polymorphism: Base class pointer, object slicing, late binding, method overriding with virtual functions, pure virtual functions, abstract classes.
Operator Overloading: This pointer, applications of this pointer, Operator function, member and non member operator function, operator overloading, I/O operators.
Exception handling: Try, throw, and catch, exceptions and derived classes, function exception declaration.

**Module III**

(08 hrs)
Dynamic memory management, new and delete operators, object copying, copy constructor, assignment operator, virtual destructor.
Template: template classes, template functions.
Namespaces: user defined namespaces, namespaces provided by library.

**Text Books:**
1. Object Oriented Programming with C++ - E. Balagurusamy, McGraw-Hill Education (India)
2. ANSI and Turbo C++ - Ashoke N. Kamthane, Pearson Education

**Reference Books:**
1. Big C++ - Wiley India
2. C++: The Complete Reference- Schildt, McGraw-Hill Education (India)
5. Mastering C++ - Venugopal, McGraw-Hill Education (India)

PCMF 7302 MACHINE DESIGN SESSIONAL (0-0-3)

LIST OF EXPERIMENTS:

1. Design of coupling - Rigid & flexible type
2. Design of riveted joints (under axial & eccentric loading)
3. Design of Welded joints (under axial & eccentric loading)
4. Design of cotter & knuckle joint
5. Design & Analysis of leaf & Helical springs under various loading
6. Design of Piston
7. Design of Connected rod/crankshaft,
8. Design of Spur gear under various loading
9. Design of Helical & bevel gear under various loading
10. Design of Screw Jack under various loading
11. Practice in computer aided design of some of the above mentioned design using 3D Software

PCMF 7303 MANUFACTURING LABORATORY - III (0-0-3)
(DYNAMIC LAB)

LIST OF EXPERIMENTS:

1. a) Study of gear parameters.
   b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential 20 gear trains.
2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
   b) Kinematics of single and double universal joints.
3. a) Determination of Mass moment of inertia of Fly wheel and Axle system.
   b) Determination of Mass Moment of Inertia of axis symmetric bodies using Turn Table apparatus.
   c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
4. Motorized gyroscope - Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
6. Cams - Cam profile drawing, Motion curves and study of jump phenomenon
7. a) Single degree of freedom Spring Mass System - Determination of natural frequency and verification of Laws of springs - Damping coefficient determination.
   b) Multi degree freedom suspension system - Determination of influence coefficient.
8. a) Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies.
   b) Vibration Absorber - Tuned vibration absorber.
9. Vibration of Equivalent Spring mass system - Undamped and damped vibration.
10. Whirling of shafts - Determination of critical speeds of shafts with concentrated Loads.
    b). Balancing of reciprocating masses.
12. a) Transverse vibration of Free-Free beam - with and without concentrated masses.
    b) Forced Vibration of Cantilever beam - Mode shapes and natural frequencies.
    c) Determination of transmissibility ratio using vibrating table.
1. Microstructure analysis of steel (Mild, Medium carbon, High carbon, Hardened & Spheroidised Steel), Cast iron
2. Jominy and Quench test apparatus
3. Microstructure analysis of Non ferrous alloys
4. Heat treatment of steel
5. Cooling curve experiment
6. Liquid penetrant test
7. Ultrasonic flaw detection
8. Magnetic particle testing
9. Eddy current testing.