JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(Established by Govt. of A.P., Act. No. 30 of 2008)

ANANTHAPURAMU – 515 002 (A.P.) INDIA.

Course Structure for B.Tech-R15 Regulations

Mechanical Engineering

B.Tech III-I Semester (ME)

S. No.	Course Code	Subject	L	T	P	C
1.	15A01510	Fluid Mechanics and Hydraulic Machines	3	1	-	3
2.	15A03501	Thermal Engineering - II	3	1	-	3
3.	15A03502	Dynamics of Machinery	3	1	-	3
4.	15A03503	Machine Tools	3	1	-	3
5.	15A03504	Design of Machine Members - I	3	1	-	3
6.	15A03505 15A03506 15A03507	**MOOCS -I** a. Entrepreneurship b. Nano Technology c. Micro Electro Mechanical Systems	3	1	-	3
7.	15A01511	Fluid Mechanics and Hydraulic Machines Laboratory	-	-	4	2
8.	15A03508	Machine Tools Laboratory	-	-	4	2
9.	15A99501	Audit course – Social Values & Ethics	2	0	2	0
		Total:	**20**	**6**	**10**	**22**

B.Tech III-II Semester (ME)

S. No.	Course Code	Subject	L	T	P	C
1.	15A03601	Operations Research	3	1	-	3
2.	15A03602	Design of Machine Members – II	3	1	-	3
3.	15A03603	Heat Transfer	3	1	-	3
4.	15A03604	Finite Element Method	3	1	-	3
5.	15A03605	Metal forming Process	3	1	-	3
6.	15A03606 15A03607	**CBCC-I** a. Non Conventional Source of Energy b. Total Quality Management	3	1	-	3

	15A03608 15A01608	c. Mechatronics d. Intellectual Property Rights				
7.	15A03609	Heat Transfer Laboratory	-	-	4	2
8.	15A03610	Computer Aided Engineering Laboratory	-	-	4	2
9.	15A52602	Advanced English Language Communication Skills (AELCS) Laboratory (Audit Course)			2	-
10.	15A03611	Comprehensive Online Examination - II	-	-	-	1
		Total:	**18**	**6**	**11**	**23**

There shall be a comprehensive online examination conducted by the respective colleges with 60 objective questions for 60 marks on the subjects studied in the third year (I & II semesters). The Principals of the respective colleges are given the responsibility of preparing question bank/ question paper and conducting the online examination maintaining confidentiality. A student shall acquire 1 credit assigned to the comprehensive online examination only when he/she secures 40% or more marks. In case, if a student fails in comprehensive online examination, he shall reappear/ re-register by following a similar procedure adopted for the lab examinations.

B.Tech IV-I Semester (ME)

S. No.	Course Code	Subject	L	T	P	C
1.	15A52601	Management Science	3	1	-	3
2.	15A03701	Automobile Engineering	3	1	-	3
3.	15A03702	CAD/CAM	3	1	-	3
4.	15A03703	Metrology and Measurements	3	1	-	3
5.	 15A03704 15A03705 15A03706	**CBCC-II** a. Refrigeration and Air – Conditioning b. Tool Design c. Modern Manufacturing Methods	3	1	-	3
6.	 15A03707 15A03708 15A03709	**CBCC-III** a. Computational Fluid Dynamics b. Automation and Robotics c. Production & Operations Management	3	1	-	3
7.	15A03710	CAD/ CAM Laboratory	-	-	4	2
8.	15A03711	Metrology and Measurements Laboratory	-	-	4	2
		Total:	**18**	**6**	**8**	**22**

B.Tech IV-II Semester (ME)

S. No.	Course Code	Subject	L	T	P	C
1.	15A03801 15A03802 15A03803	**MOOCS-II** a. Industrial Engineering b. Product Design c. Composite Materials	3	1	0	3
2.	15A03804 15A03805 15A03806	**MOOCS -III** a. Power Plant Engineering b. Gas Turbines and Jet Propulsion c. Energy Management	3	1	0	3
3.	15A03807	Comprehensive Viva Voce	0	0	4	2
4.	15A03808	Technical Seminar	0	0	4	2
5.	15A03809	Project work	0	0	24	12
		Total:	**6**	**2**	**32**	**22**

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B. Tech III-I Sem. (ME)

L	T	P	C
3	1	0	3

15A01510 FLUID MECHANICS AND HYDRAULIC MACHINES

UNIT - I

FLUID STATICS : Dimensions and units: physical properties of fluids – specific gravity, porosity surface tension – vapor pressure and their influence on fluid motion – atmospheric gauge and vacuum pressure – measurement of pressure – Piezometer, U-tube differential manometers.

FLUID KINEMATICS : stream line, path line and streak lines and steam tube, classification of flows-steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows-equation of continuity for one dimensional flow.

Fluid dynamics: surface and body forces – Euler's and Bernoulli's equations for flowing stream line, momentum equation and its application on force on pipe bend.

UNIT – II

CONDUIT FLOW: Reynold's experiment – Darcy Weisbach equation – Minor losses in pipes – pipes in series and pipes in parallel – total energy line-hydraulic gradient line. Measurement of flow: pitot tube, venturimeter and orifice meter, Flow nozzle and Turbine current meter.

UNIT – III

TURBO MACHINERY : hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done efficiency, flow over radial vanes.

HYDROELECTRIC POWER STATIONS: Elements of hydro electric power station-types-concept of pumped storage plants-storage requirements.

UNIT – IV

HYDRAULIC TURBINES: Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design-draft tube- theory- functions and efficiency.

PERFORMANCE OF HYDRAULIC TURBINES : Unit and specific quantities, characteristics, governing of turbines, selection of type of turbine, cavitation and surge tank.

UNIT – V

CENTRIFUGAL PUMPS : Classification- working-work done – manomertic head – loss efficiencies – specific speed – pumps in series and parallel – performance characteristic curves and NPSH.

TEXT BOOKS :

1. Fluid Mechanics, Hydraulic and Hydraulic Machines by Modi & Seth, Standard book house.
2. A Text of Fluid Mechanics and Hydraulic Machines by Dr.R.K.Bansal – Laxmi Publications (P) Ltd., New Delhi.
3. Mechanics of Fluids by Potter, Wiggert, Ramadan, M.M.M.SARCAR, Cengage Publishers.

REFERENCE BOOKS :

1. Fluid Mechanics and Machinery by D.Rama Durgaiah, New Age International.
2. Principles of Fluid Mechanics and Fluid Machines by M.Narayana Pillai, Universities Press.
3. Fluid mechanics and fluid machines by Rajput, S.Chand & Co.

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B. Tech III-I Sem. (ME)

L	T	P	C
3	1	0	3

15A03501 THERMAL ENGINEERING – II

Course Objective:

This subject is designed to provide a sound knowledge in various aspects of thermal equipments. This subject has an increasingly dominant role to play in the vital areas of power generation, Automobiles, R&AC and energy sector. The course contents aims at developing the necessary analytical and technical contents among engineers in these areas. The students shall become familiar with steam power plant, boilers, function of nozzle, gas turbines and jet propulsions.

UNIT I

BASIC CONCEPTS: Rankine Cycle - Schematic Layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat Addition, Methods to Improve Cycle Performance – Regeneration – Reheating- Combined- Cycles.

Learning Outcome & Suggested Student Activities:

Student can be able to illustrate the power generation through Rankine cycle. Student can able understand efficiency enhancement methods of Reheating and regeneration. Student can able to understand the key role of quality of steam after evaporation.

Students are advised to be acquainted with the terms related to steam, steam tables and mollierchart.Also, students are advised to visit the thermal power station to get real expose.

UNIT II

BOILERS: Classification Based on Working Principles & Pressures of Operation - L.P & H.P. Boilers – Mountings and Accessories.

DRAUGHT: Classification – Height Of Chimney for Given Draught and Discharge, Condition for Maximum Discharge, Efficiency of Chimney – Artificial Draught, Induced and Forced Draught.

Learning Outcome & Suggested Student Activities:

Student can able to understand the working of different high pressure and low pressure boilers. Student can distinguish mountings and accessories. The student can calculate the chimney height for maximum discharge. Student can know the draughts and its application in the steam generator. Students are advised to visit the Boilers in the power generation units to get better expose. And visit the following URLs will be highly useful to the students to understand various aspects of thermal power plants and boilers.

https://www.youtube.com/watch?v=Ota2_LUuar0,

https://www.youtube.com/watch?v=8GSUgwombdE

UNIT III

STEAM NOZZLES: Function of Nozzle – Applications - Types, Flow through Nozzles, Thermodynamic Analysis – Assumptions -Velocity of Nozzle at Exit-Ideal And Actual Expansion in Nozzle, Velocity Coefficient, Condition for Maximum Discharge, Critical Pressure Ratio.

Criteria for Design of Nozzle Shape: Super Saturated Flow and its Effects, Degree of Super Saturation and Degree of Under Cooling - Wilson Line –Shock at The Exit.

CONDENSERS: Classification, Air Leakage Vacuum Efficiency, condenser efficiency, problems.

Learning Outcome & Suggested Student Activities:

Student can be able to distinguish the ideal flow and actual flow through nozzle. Student can know the importance of maximum discharge through nozzle. Student can able to entail the concept of Critical pressure ratio in calculations. Student can able to understand the effect of meta stable flow/ super saturation flow through nozzle.

Students are advised to visit the thermal power stations to acquire the practical expose and visit URL http://www.youtube.com/watch?v=cdUNmzcu2rA

UNIT IV

IMPULSE TURBINE: Mechanical Details – Velocity Diagram – Effect of Friction – Power Developed, Axial Thrust Blade or Diagram Efficiency – Condition for Maximum Efficiency. De-Laval Turbine - Its Features. Methods To Reduce Rotor Speed - Velocity Compounding And Pressure Compounding, Velocity And Pressure Variation Along The Flow – Combined Velocity Diagram For A Velocity Compounded Impulse Turbine.

REACTION TURBINE: Mechanical Details – Principle of Operation, Thermodynamic Analysis of A Stage, Degree of Reaction –Velocity Diagram – Parson's Reaction Turbine – Condition for Maximum Efficiency.

Learning Outcome & Suggested Student Activities:

At the end of unit, student can able to distinguish the working of impulse and reaction turbines. Student can able to construct the velocity triangle and combined velocity triangle and can learn its importance in determining the power produced by the turbine. Student can know why to reduce the rotor speed and methods to reduce.

Students are advised to visit thermal power stations for better understanding the working of turbines. Students are suggested to participate in science exhibitions based on the concept of thermal power plants. Student is advised to visit following URLs http://www.youtube.com/watch?v=y2dOmpZgYW8&list=PLBD7B1EEF7CCB7D9D , https://www.youtube.com/watch?v=1bI1Q3V_79I

UNIT V

GAS TURBINES:Simple Gas Turbine Plant – Ideal Cycle, Essential Components – Parameters of Performance – Actual Cycle – Regeneration, Inter Cooling and Reheating – Closed And Semi-Closed Cycles – Merits and Demerits, Brief Concepts of Compressors, Combustion Chambers and Turbines used in Gas Turbine Plants

JET PROPULSION: Principle of Operation – Classification of Jet Propulsive Engines – Working Principles with Schematic Diagrams and Representation on T-S Diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo Jet, Turbo Prop, Pulse Jet Engines – Schematic Diagram, Thermodynamic Cycle. Introduction to Rocket Propulsion.

Learning Outcome & Suggested Student Activities:

After the study of the unit, Student can be familiar with the basic components of a gas turbine power plant. Student can illustrate the power generation using Joule Cycle. Student can know the methods to increase the specific power output and efficiency of the cycle. Also, Student can able to know the working of various propulsive devices. Student can aware of using thrust equations in solving problems. Students advised to visit Gas power generation plants.

http://www.youtube.com/watch?v=hnVWpOV5chs,http://www.youtube.com/watch?v=p1TqwAKwMuM , http://www.youtube.com/watch?v=MUxP3PCDRTE

Text Books:

1. *Thermal Engineering, R.K. Rajput, 9/e, Lakshmi Publications, 2013*
2. *Basic and Applied Thermodynamics, P.K. Nag, TMH , 2nd Edition,2012.*

Reference Books:

1. *Gas Turbines, V. Ganesan, TMH*
2. *Thermodynamics and Heat Engines, R.Yadav, Central Publishing House, Allahabad, 2002.*
3. *Thermal Engineering, Mahesh M Rathore, McGrawHill,2010*
4. *Gas Turbines and Propulsive Systems, P.Khajuria&S.P.Dubey, Dhanpatrai*
5. *Thermal Engineering, R.S Khurmi & JS Gupta, S.Chand, 2012.*
6. *Thermal Engineering Data Book, B.S. Reddy and K.H. Reddy, I.K. International, 2007.*
7. *Steam Tables SI Units- Dr.B.Umamaheswar Gowd and A. Nagraju, Siri Publ.*

NOTE: *Steam tables and Mollier charts to be supplied for exam.*

Web References:

http://www.iscid.org/encyclopedia/Tthermodynamics. http://www.transtutors.com/

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B. Tech III-I Sem. (ME)

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15A03502 DYNAMICS OF MACHINERY

Course objective:
To understand the method of static force analysis and dynamic force analysis of mechanism, undesirable effects of unbalance in rotors and engines. To understand the concept of vibratory systems and their analysis and also the principles of governors.

UNIT I

FRICTION: Inclined plane, friction of screws and nuts, pivot and collar, uniform pressure, uniform wear. Friction circle and friction axis, lubricated surfaces, boundary friction, film lubrication.

CLUTCHES: Friction clutches- Single Disc or plate clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch.

BRAKES AND DYNAMOMETERS: Simple block brakes, Band brake, internal expanding brake, braking of vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

Learning outcome & Suggested Student Activities:
After completion of this unit students are able to understand the basic concepts of friction in pivots and collars with uniform pressure and uniform wear, and also to solve the numerical problems on brakes, clutches and dynamometers.
Students may go through text books given for more number of problems on friction, brakes and clutches. The following URLs will be highly useful to the students to understand various concepts of friction and its application.
http://nptel.iitm.ac.in/video.php?subjectId=112104121,
http://www.youtube.com/watch?v=FA04XFpJgwE

UNIT II

PRECESSION: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aeroplanes and ships.

TURNING MOMENT DIAGRAMS AND FLY WHEELS: Turning moment diagrams for steam engine, IC Engine and multi cylinder engine. Crank effort - coefficient of Fluctuation of energy, coefficient of Fluctuation of speed – Fly wheels and their design, Fly wheels for Punching machines.

Learning outcome & Suggested Student Activities:
After completion of this unit students can apply gyroscopic principles on Aeroplane, ship, four wheel and two wheel vehicles. Students are able to design a flywheel for IC engine. Students may go through text books given for more number of problems on gyroscopic

effects and flywheels. The following URLs will be highly useful to the students to understand various concepts of gyroscopic couple and turning moment diagrams.
http://www.youtube.com/watch?v=FydJu1A1oeM&list=PL46AAEDA6ABAFCA78&index=7
http://www.youtube.com/watch?v=swgvKwyOnYk&list=PL46AAEDA6ABAFCA78&index=16

UNIT III

GOVERNORS: Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting. Effort and power of a governor.

Learning outcome & Suggested Student Activities:
The outcome of this unit is to study the basics and definitions related to governors and forces acting on various governors. After completion of this unit students are able to solve numerical problems on different governors.
Students may go through text books given for more number of problems on governors. The following URLs will be highly useful to the students to understand various concepts on governors.
http://nptel.iitm.ac.in/video.php?subjectId=112104121,
http://www.youtube.com/watch?v=OG1AiaNTT6s

UNIT IV

BALANCING: Balancing of rotating masses - single and multiple – single and different planes.

BALANCING OF RECIPROCATING MASSES: Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples – V-engine, multi cylinder in-line and radial engines for primary and secondary balancing.

Learning outcome & Suggested Student Activities:
After completion of this unit students can solve numerical problems on balancing of rotating masses and reciprocating masses in V-engine and multi cylinder engines.
Students may go through text books given for more number of problems on balancing of rotating masses and balancing of reciprocating masses in locomotives and IC engines. The following URLs will be highly useful to the students to understand various concepts of balancing of masses.
http://www.youtube.com/watch?v=aRulDXMuNDc&list=PL46AAEDA6ABAFCA78&index=8
http://nptel.iitm.ac.in/video.php?subjectId=112104121

UNIT V

VIBRATION: Free and forced vibration of single degree of freedom system, Role of damping, whirling of shafts and critical speeds. Simple problems on free, forced and damped vibrations. Vibration Isolation & Transmissibility. Transverse vibrations of

beams with concentrated and distributed loads. Dunkerly's method, Raleigh's method. Torsional vibrations - two and three rotor systems.

Learning outcome & Suggested Student Activities:

Upon completion of this unit, the student will perform detailed analysis of the response of one degree of freedom systems with free and forced vibrations, evaluate the critical speed of the shaft and simple vibration calculations of rotor systems. Students may go through text books given for more number of problems on single degree of freedom system, transverse and torsional vibrations. The following URLs will be highly useful to the students to understand various concepts on vibrations.
http://nptel.iitm.ac.in/video.php?subjectId=112104121
http://www.youtube.com/watch?v=irudCaBrij0&list=PL46AAEDA6ABAFCA78&index=30

Text Books:

1. *Theory of Machines, S.S. Rattan, MGH Publishers,3rd Edition,2013.*
2. *Kinematics and Dynamics of Machinery R.L. Norton, Tata McGraw Hill.*

Reference Books:

1. *Theory of Machines, Thomas Bevan, Pearson, 3rd Edition,2012.*
2. *The theory of Machines, Ballaney, Kanna Publishers*
3. *Theory of Machines and Mechanisms of Shigley et.al. Oxford International Student Edition.*

NOTE: *End Exam Should be conducted in Drawing Hall*

Suggestions:

Students may visit near by machine tool shops and automobile work shops to know about clutches, bearings, brakes, dynamometers, flywheel, centrifugal governors and balancing equipment like wheel balancing. Students are suggested to search the web and identify different URLs which provide animations of mechanisms for better visualization and understanding purpose.

Web References:

Machine Dynamics by Prof. Amitabha Ghosh, IITK, Kanpur - http://nptel.iitm.ac.in/video.php?subjectId=112104114
Machine Dynamics by Prof. C. Amarnath, Prof. K. KurienIssac, Prof. P. Seshu of IITB, Mumbai
http://www.cdeep.iitb.ac.in/nptel/Mechanical/Dynamics%20of%20Machines/TOC.html

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B. Tech III-I Sem. (ME)

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15A03503 MACHINE TOOLS

Course Objective:

The objectives of this course are to introduce to demonstrate the fundamentals of machining processes and machine tools.

To develop knowledge and importance of metal cutting parameters, tool materials, cutting fluids and tool wear mechanisms.

To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes and acquire knowledge on advanced manufacturing processes. The students will have the knowledge and hands-on experience that will enable them to work in a typical machine shop.

UNIT I

Elementary treatment of metal cutting theory – Elements of cutting process – Geometry of single point tool and angles, chip formation and types of chips – built up edge and its effects, chip breakers. Mechanics of orthogonal cutting –Merchant's Force diagram, cutting forces – cutting speeds, feed, depth of cut, heat generation, tool life, coolants, machinability –economics of machining. cutting Tool materials and cutting fluids –types and characteristics .

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the basic concepts of the philosophy of metal cutting and the mechanism of chip formation. Student will understand the interface in the machining zone between the tool and the work piece and how the physical and mechanical parameters dictate the cutting performance.

UNIT II

Engine lathe – Principle of working- specification of lathe – types of lathes – work holders and tool holders –Taper turning, thread turning and attachments for Lathes.Turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classification – Single spindle and multi-spindle automatic lathes– tool layout and cam design.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the basic concepts of turning. Student shall be made familiar with various tooling accessories used in turning and understand different constructions of lathe depending on the nature of operation.

UNIT III

Drilling and Boring Machines – Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring tools – machining time calculation.

Shaping, Slotting and Planning machines –Principles of working – Principal parts – specification, classification, Operations performed. Machining time calculations

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the basic principle of drilling, shaping and planning operation, parts of the drilling, shaping and planning machines and tool holding devices, operations performed on drilling, shaping and planning and machining calculations.

UNIT IV

Milling machine – Principles of working – specifications – classifications of milling machines – Principal features – machining operations, Types and geometry of milling cutters– methods of indexing – Accessories to milling machines.

Grinding machine –Theory of grinding – classification– cylindrical and surface grinding machine – Tool and cutter grinding machine – special types of grinding machines – Grinding wheel: Different types of abrasives – bonds, specification and selection of a grinding wheel. Static and dynamic balancing of a wheel Truing and Dressing of wheels. Lapping, Honing and Broaching machines – comparison of grinding, lapping and honing. machining time calculations.

Learning outcome &Suggested Student Activities:

After completion of this unit students are able to understand the principle of milling, grinding, Lapping, Honing and Broaching operation, parts of the milling machine and types of milling and grinding machines.

UNIT V

Principles of design of Jigs and fixtures and uses, 3-2-1 Classification of Jigs & Fixtures – Principles of location and clamping – Types of clamping & work holding devices, Typical examples of jigs and fixtures

Unit built machine tools – multispindle heads. power units-principal of working types of UBMTS, characterization, applications

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the design of Jigs and fixtures and uses, Classification of Jigs & Fixtures – Principles of location and clamping. Some examples of jigs and fixtures. The outcome of this unit is to understand the basic principle of unconventional machining methods USM,AJM,EDM,LBM,EBM,CM and ECM and machining of the USM,AJM,EDM,LBM,EBM,CM and ECM.

Text Books:

1. *Workshop Technology – Vol II, B.S.RaghuVamshi, Dhanpat Rai & Co, 10th edition, 2013*
2. *Production Technology by R.K. Jain and S.C. Gupta, Khanna Publishers, 17th edition, 2012*

Reference Books:

1. *Manufacturing Technology-Kalpakzian- Pearson*
2. *Metal cutting Principles by Milton C.Shaw, oxford Second Edn, 2nd edition, 2012*
3. *Production Technology by H.M.T. (Hindustan Machine Tools),TMH, 1st edition, 2001*
4. *Production Technology by K.L.Narayana, IK International Pub.*
5. *Machining and machine tools by AB. Chattopadyay, WileyEdn,2013*
6. *Unconventional Machining process by V.K.Jain, Allied Pub.*
7. *Manufacturing technology Vol II by P.N. Rao, Tata McGraw Hill, 4th edition, 2013*
8. *Machine Technology Machine tools and operations by Halmi A Yousuf&Harson, CRC Press Taylor and Francies .*

Web Resources:

www.hgfarley.com
www.kennametal.com/ - United States
www.mini-lathe.com/links.htm;machinedesign.com/.../designer-s-guide-tometalcutting-machinery-0608 -
www.metalwebnews.com/wc.html
www.britannica.com/EBchecked/topic/463000/planer
www.americanmachinist.com
www.machinetools.net.tw/parts/taiwan_voltage_regulator.htm

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B. Tech III-I Sem. (ME)

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15A03504 DESIGN OF MACHINE MEMBERS – I

Course Objective:

The primary objective of this course is to demonstrate how engineering design is used for many principles learned in previous engineering science courses and to show how these principles are practically applied. This subject will help to the students to learn to analyze and design basic machine elements in mechanical systems. By this subject students will become familiar on design principles, materials selection, stresses developed in machine elements under different loads. The students will also get knowledge on design of the permanent and temporary joints, shafts and keys.

UNIT I

INTRODUCTION: General considerations of design, design process. Selection of Engineering Materials - properties –Manufacturing considerations in the design. BIS codes of materials, preferred numbers and interchangeability.

STRESSES IN MACHINE MEMBERS: Simple stresses – Combined stresses – Torsional and bending Stresses – impact stresses – stress -strain relation – Theories of failure – factor of safety.

Learning Outcome & Suggested Student Activities:

After completion of this unit students are capable to apply design procedures using theories of failure for different elements. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of machine design.
http://machinedesign.com/
http://www.youtube.com/watch?v=qVj4VvMmQjc&list=PL3D4EECEFAA99D9BE&index=6

UNIT II

DESIGN FOR FLUCTUATING LOADS: Stress concentration –notch sensitivity – Design for fluctuating stresses – Estimation of Endurance strength – Goodman's line – Soderberg's line. Design of components for finite and infinite life.

Learning Outcome & Suggested Student Activities:

After completion of this chapter students are able to design simple components under cyclic loading using Goodman's and Soderberg's criterions. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of cyclic loading design. http://machinedesign.com/
http://www.youtube.com/watch?v=SLqkITQfN1I&list=PL3D4EECEFAA99D9BE&index=8

UNIT III

DESIGN OF RIVETED JOINTS: Types of riveted joints, design of riveted joints. Boiler shell riveting design and eccentric loading design of riveted joints.

DESIGN OF BOLTED JOINTS: Forms of Screw threads. Stresses in Screw fasteners. Design of bolts with pre-stresses, Design of bolted joints under eccentric loading, Bolts of uniform strength.

Learning Outcome & Suggested Student Activities:

After completion of this unit students are able to design riveted joints with different configuration, boiler shell joint design and eccentric loading design of riveted joints. Further students are able to design bolted joints with direct loading and eccentric loading. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of joints. http://machinedesign.com/ http://www.youtube.com/watch?v=Z38Aq9ykUCM&list=PL3D4EECEFAA99D9BE&index=16

UNIT IV

DESIGN OF COTTERS AND KNUCKLE JOINTS: Design of Cotter joints: spigot and socket, sleeve and cotter, jib and cotter joints- Knuckle joints

DESIGN OF SHAFTS: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads.

Learning Outcome & Suggested Student Activities:

After completion of this unit students are able to design cotter joint, knuckle joint and shafts. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of shafts, http://machinedesign.com/ http://www.youtube.com/watch?v=4nlQwVqruRo&list=PL3D4EECEFAA99D9BE&index=20

UNIT V

DESIGN OF KEYS AND COUPLINGS: Design of Rigid couplings: Muff, Split muff and Flange couplings- Design of flexible couplings.

Learning Outcome & Suggested Student Activities:

After completion of this unit students are able to design various rigid and flexible shaft couplings. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of couplings. http://machinedesign.com/

http://www.youtube.com/watch?v=4nlQwVqruRo&list=PL3D4EECEFAA99D9BE&index=21

Text Books:

1. *MachineDesign, Schaum'sseries, TMH Publishers, NewDelhi, 1st edition, 2011*
2. *MachineDesign, R.S. Kurmi and J.K. Gupta ,S.ChandPublishers, NewDelhi*

Reference Books:

1. *MachineDesign,R.K.Jain, KhannaPublishaers,New Delhi.*
2. *MachineDesign,SadhuSingh,KhannaPublishers, NewDelhi*
3. *MechanicalEngineeringDesign,JosephE.Shigely,TMH Publishers,NewDelhi, 9th edition, 2011 R*
4. *DesignofMachineElements,M.F.Spotts, PHIPublishers, NewDelhi.*
5. *MachineDesign,PandyaandShah,CharotarPublishers,Anand, 17th edition, 2009*
6. *Machine Design, R.L. Norton, Tata McGrawHillPublishers, 2nd edition, 2002*
7. *Machine Design by Groover – CBS Publications, 5th edition, 2012.*
8. *Machine Design Data Book, V B Bhandari, McGraw Hill,2014*

NOTE: *Design data books are not permitted in the examinations.*

Web Resources:

http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv077-page1.htm
http: // www .f a s t e n a l .c o m / c o n t e n t / f e d s / p d f / A r t i c l e % 2 0 - %20Bolted%20Joint%20Design.pdf
http://people.rit.edu/megite Lec%203%20Fatigue%20Faiure% 20031004_ for_students.ppt
http://engineershandbook.com/Tables/materials.htm
www.nptel.iitm.ac.in/video

Suggestions:

1. Students may visit nearby automobile workshops and machine tool shopsor IC Engine Lab/Automobile Lab to know about different machine elements like shafts, keys, couplings and riveted and bolted joints.
2. In addition to the text books students may also go through the reference books authored by V.B.
Bhandari, by Pandya and Shah for more number of numerical problems.

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15A03505 ENTREPRENEURSHIP
(MOOCS-I)

UNIT 1: Introduction to Entrepreneurship Definition Types of Entrepreneur, Entrepreneurial Traits, Entrepreneur vs. Manager, Entrepreneur vs Intrapreneur. The Entrepreneurial decision process. Ethics and Social responsibility of Entrepreneurs. Opportunities for Entrepreneurs in India and abroad.

Creating and Starting the Venture, Sources of new Ideas, Methods of generating ideas, creative problem solving, product planning and development process.

UNIT II: The Business Plan Nature and scope of Business plan, Writing Business Plan, Evaluating Business plans, Using and implementing business plans. Marketing plan, financial plan and the organizational plan, Launching formalities.

UNIT III: Financing and Managing the new venture, Sources of capital, venture capital , angel investment, Record keeping, recruitment, motivating and leading teams, financial controls. Marketing and sales controls. E-commerce and Entrepreneurship, Internet advertising.

UNIT IV: New venture Expansion Strategies and Issues, Features and evaluation of joint ventures, acquisitions, merges, franchising. Public issues, rights issues, bonus issues and stock splits.Choosing location and layout, Issues related to Selection of layout.

UNIT V: Production and Marketing Management Thrust of production management, Selection of production Techniques, plant utilization and maintenance, Designing the work place, Inventory control, material handling and quality control.Marketing functions, market segmentation, market research and channels of distribution, Sales promotion and product pricing. Global aspects of Enterprenership.

Text Books:

1Entrepreneurship, Robert Hisrich, & Michael Peters, TMH, 5th Edition
2. Entrepreneurship, Dollinger, Pearson, 4/e 2004.

REFERENCES:

1. Dynamics of Entrepreneurial Development and management, Vasant Desai, Himalaya Publishing House, 2004.
2. Harvard Business Review on Entrepreneurship. HBR Paper Back, 1999.
3. Entrepreneurial Management, . Robert J.Calvin:, TMH, 2004.

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15A03506 NANO TECHNOLOGY
(MOOCS-I)

Course objective

On successful completion of the course, students should be able to: Understand the basic cientific concepts of nanoscience. Understand the properties of nano materials, characterization of materials, synthesis and fabrication. Understand the applications of nano technology in various science, engineering and technology fields.

UNIT-I

INTRODUCTION: History of nano science, definition of nano meter, nano materials, nano technology. Classification of nano materials. Crystal symmetries, crystal directions, crystal planes. Band structure.

PROPERTIES OF MATERIALS:

Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

UNIT-II

SYNTHESIS AND FABRICATION: Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top Down Approach – Ball milling, micro fabrication, lithography. Requirements for realizing semiconductor nano structures, growth techniques for nano structures.

UNIT-III

CHARECTERIZATION TECHNIQUES: X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, atomic force microscopy, piezoresponse microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, Raman spectroscopy.

UNIT-IV

CARBON NANO TECHNOLOGY:

Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nano crystalling diamond films, grapheme, applications of carbon nano tubes.

UNIT-V

APPLICATIONS OF NANO TECHNOLOGY:

Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin fins, applications of quantum dots.

TEXT BOOK:

1. Nano science and nano technology / M.S Ramachandra Rao, Shubra Singh/Wiley publishers.
2. Introduction to Nanotechnology by Risal Singh, Shipra Mital Gupta, Oxford Higher Education, First Publication 2016.

REFERENCE BOOKS:

1. Introduction to Nano Technology /Charles P. Poole, Jr., Frank J.Owens/Wiley publishers.
2. Nanotechnology /Jermy J Ramsden/Elsevier publishers
3. Nano Materials/A.K.Bandyopadhyay/ New Age
4. Nano The Essentials, T.Pradeep, McGrawHill, 2014
5. Nanotechnology the Science of Small / M.A Shah, K.A Shah/Wiley Publishers.

Course outcomes:

- Upon successful completion of this course the student shall be able to:
- Identify the essential concepts used in nanotechnology. Identify the materials, properties, syntheses and fabrication, characterization and applications in various fields.

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15A03507 MICRO ELECTRO MECHANICAL SYSTEMS (MEMS) (MOOCS-I)

Course Objectives:

1. To learn basics of Micro Electro Mechanical Systems (MEMS).
2. To learn about various sensors and actuators used in MEMS
3. To learn the principle and various devices of MOEMS, Fluidic, bio and chemical systems

UNIT – I

INTRODUCTION: Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.
MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

UNIT – II

THERMAL SENSORS AND ACTUATORS: Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

UNIT – III

MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS: Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators

UNIT – IV

MICRO FLUIDIC SYSTEMS: Applications, considerations on micro scale fluid, fluid actuation methods, dielectro phoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps.

RADIO FREQUENCY (RF) MEMS: RF – based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

UNIT - V

CHEMICAL AND BIO MEDICAL MICRO SYSTEMS: Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.

TEXT BOOK:

1. MEMS/Nitaigour Premchand Mahalik/TMH Publishing co.
2. MEMS and NEMS/Sergey Edwrd Lyshevski/CRC Press, Indian Edition, 2013

REFERENCE BOOKS:

1. Foundation of MEMS/Chang Liu/Prentice Hall Ltd.
2. RF MEMS Theory, Design and Technology Gabriel M. Rebeiz, Wiley-India,2010
3. MEMS and Micro Systems: Design and Manufacture/Tai-Ran Hsu/TMH Publishers.
4. Introductory MEMS/ Thomas M Adams, Richard A Layton/Springer International Publishers.

Course outcomes:

Upon successful completion of this course the student shall be able to know the importance and various devices of MEMS and their applications.

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15A01511 FLUID MECHANICS AND HYDRAULIC MACHINES LABORATORY

OBJECTIVE: *The object of the course to make the students understand the fluid flow concepts and get familiarity with flow measuring devices.*

SYLLABUS :

1. Calibration of Venturimeter
2. Calibration of Orifice meter
3. Determination of Coefficient of discharge for a small orifice by a constant head method.
4. Determination of Coefficient of discharge for an external mouth piece by variable head method.
5. Calibration of contracted Rectangular Notch and /or Triangular Notch.
6. Determination of Coefficient of loss of head in a sudden contraction and friction factor.
7. Varification of Bernoulli's equation.
8. Impact of jet on vanes.
9. Study of Hydraulic jump.
10. Performance test on Pelton wheel turbine.
11. Performance test on Francis turbine.
12. Efficiency test on centrifugal pump.

LIST OF EQUIPMENT :

1. Venturimeter Setup.
2. Orifice meter setup.
3. Small orifice setup.
4. External mouthpiece setup.
5. Rectangular and Triangular notch setups.
6. Friction factor test setup.
7. Bernoulli's theorem setup.
8. Impact of jets.
9. Hydraulic jump test setup.
10. Pelton wheel and Francis turbines.
11. Centrifugal pumps.

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15A03508 MACHINE TOOLS LABORATORY

1. Demonstration of construction & operations of general purpose machines: Lathe, Drilling machine, Milling machine, Shaper, Planning machine, Slotting machine, Cylindrical Grinder, Surface grinder and Tool & cutter grinder.
2. Job on Step turning and taper turning on lathe machine
3. Job on Thread cutting and knurling on -lathe machine.
4. Job on Drilling and Tapping
5. Job on Shaping and Planning
6. Job on Slotting
7. Job on Milling (groove cutting/ gear cutting)
8. Job on Cylindrical and Surface Grinding
9. Job on Grinding of Tool angles.

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15A99501 SOCIAL VALUES & ETHICS (AUDIT COURSE)

(Common to all Branches)

UNIT - I

Introduction and Basic Concepts of Society: Family and Society: Concept of family, community, PRIs and other community based organizations and society, growing up in the family – dynamics and impact, Human values, Gender Justice.

Channels of Youth Moments for National Building: NSS & NCC: History, philosophy, aims & objectives; Emblems, flags, mottos, songs, badge etc.; Organizational structure, roles and responsibilities of various NSS functionaries. **Nehru Yuva Kendra (NYK):** Activities – Socio Cultural and Sports.

UNIT – II

Activities of NSS, NCC, NYK:

Citizenship: Basic Features Constitution of India, Fundamental Rights and Fundamental Duties, Human Rights, Consumer awareness and the legal rights of the consumer, RTI.

Youth and Crime: Sociological and psychological Factors influencing youth crime, Peer Mentoring in preventing crimes, Awareness about Anti-Ragging, Cyber Crime and its prevention, Juvenile Justice

Social Harmony and National Integration: Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building.

UNIT – III

Environment Issues: Environment conservation, enrichment and Sustainability, Climate change, Waste management, Natural resource management (Rain water harvesting, energy conservation, waste land development, soil conservations and afforestation).

Health, Hygiene & Sanitation: Definition, needs and scope of health education, Food and Nutrition, Safe drinking water, Sanitation, Swachh Bharat Abhiyan.

Disaster Management: Introduction to Disaster Management, classification of disasters, Role of youth in Disaster Management. Home Nursing, First Aid.

Civil/ Self Defense: Civil defense services, aims and objectives of civil defense, Need for self defense training – Teakwondo, Judo, karate etc.,

UNIT – IV

Gender Sensitization: Understanding Gender – Gender inequality – Role of Family, Society and State; Challenges – Declining Sex Ratio – Sexual Harassment – Domestic Violence; Gender Equality – Initiatives of Government – Schemes, Law; Initiates of NGOs – Awareness, Movements;

UNIT - V

Physical Education : Games & Sports: Health and Recreation – Biolagical basis of Physical activity – benefiets of exercise – Physical, Psychological, Social; Physiology of Musucular Activity, Respiration, Blood Circulation**.**

Yoga: Basics of Yoga – Yoga Protocol, Postures, Asanas, Pranayama: Introduction of Kriyas, Bandhas and Mudras.

TEXT BOOKS:

1. NSS MANUAL
2. SOCIETY AND ENVIRONMENT: A.S.Chauha, Jain Brothers Publications, 6th Edition, 2006
3. INDIAN SOCIAL PROBLEM: G.R.Madan, Asian Publisher House
4. INDIAN SOCIAL PROBLEM: Ram Ahuja, Rawat Publications
5. HUMAN SOCIETY: Kingsley Davis, Macmillan
6. SOCIETY: Mac Iver D Page, Macmillan
7. SOCIOLOGY – THEMES AND PERSPECTIVES: Michael Honalambos, Oxford University Press
8. CONSTITUTION OF INDIA: D.D.Basu, Lexis Nexis Butterworth Publishers
9. National Youth Policy 2014 (available on www.yas.nic.in)
10. TOWARS A WORLD OF EQUALS: A.Suneetha, Uma Bhrugudanda, Duggirala Vasantha, Rama Melkote, Vasudha Nagraj, Asma Rasheed, Gogu Shyamala, Deepa Streenivas and Susie Tharu
10. LIGHT ON YOGA : B.K.S.Iyengar, Penguin Random House Publishers

www.un.org
www.india.gov.in
www.yas.nic.in
http://www.who.int/countries/ind/en/
http://www.ndma.gov.in
http://ayush.gov.in/event/common-yoga-protocol-2016-0

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15A03601 OPERATIONS RESEARCH

Course Objective:

The subject should enable the students to the nature and scope of various decision making situations within business contexts, understand and apply operation research techniques to industrial applications,

To make the student capable of Formulating the various real life decision making problems as Mathematical programming problems. Students to learn the fundamental Techniques of Operations Research and to choose a suitable OR technique to solve problem on hand.

UNIT I

Introduction to OR and Linear Programming-1

OR definition– Classification of Models –Types of Operations Research models;

Linear Programming- Problem Formulation, Graphical Method, Simplex Method, Two–Phase Simplex Method, Big-M Method

Special Cases of LP- Degeneracy, Infeasibility and Multiple Optimal Solutions;

Learning Outcome & Suggested Student Activities:

At the end of the Unit, the student will be able to create mathematical models of the real life situations and capable of obtaining best solution using Graphical Method and Simplex Method.

(The student must refer to any of the text books and practice solving several problems as it is very common to make mistakes while solving due to lack of practice). The student should take up a real life problem and formulate it as a mathematical programming problem.

Further, the students may visit the following URL for live online tutorial for LPP formulation

http://www.www.mathsdoctor.tv

UNIT II

Linear programming-2: Duality- Principle, Economic Interpretation of Duality, Dual Simplex Method

Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution- North-West Corner Rule, Least Cost Method, Vogel's Approximation Method;

OptimalityTesting.

Special Cases -Unbalanced Transportation Problem, Degenerate Problem;

Assignment Problem – Formulation; Optimal Solution -Traveling Salesman problem.

Learning Outcome &Suggested Student Activities:
At the end of this Unit, the student must be able to implement the theory of duality for simplifying the solution procedure for certain LPPs, and solve the special cases of LPP such as Transportation and Assignment problems. A large number of problems are to be solved by the student in order to gain much required capability of handling the problems without mistakes.
The following URLs will be useful to the students for in-depth knowledge
http://nptel.iitm.ac.in/video.php?subjectId=112106134,
http://www. Math.harvard.edu/archive/20_spring_05/handouts

UNIT III

Game Theory: Introduction – Minimax (Maximin) Criterion and Optimal Strategy, Saddle Point, Solution of Games with Pure Strategy –Games with Mixed Strategies– Dominance Principle–Graphical Method, Algebraic methods, sub matrices method.
Queuing Theory: Introduction –Terminology, Service Channel, Arrival Pattern, Population, Departure Pattern(Service Pattern), Queue Discipline, Birth & Death Process, Balking, Reneging, Jockeying; Single Channel Models with Poisson Arrivals, Exponential Service Times with finite queue length and non-finite queue length; Multichannel Models with Poisson Arrivals, Exponential Service Times with finite queue length and non finite queue length.

Learning Outcome & Suggested Student Activities:
At the end of this Unit, the student will have knowledge of choosing the best strategy out of the available strategies which is an essential skill for any business manager to successfully face the competition. The following web link will direct the students to the video lecture on Game Theory.
http://www.youtube.com/watch?feature=player_detailpage&v=h0bdo06qNVw
The student will be capable of identifying the suitable Queuing Model for real world waiting lines and make estimations like Average Waiting Times, Average Queue Length, Probability of Waiting in the queue etc.
The students may watch the following web video for better understanding of the subject.
http://www.youtube.com/watch?feature=player_detailpage&v=xGkpXk-AnWU#t=104s
The students should refer to any OR text book for more number of practice problems.

UNIT IV

Sequencing -Assumptions-n-jobs-2 Machines model, n-jobs-3-machines models & n jobs – m Machines models.
PERT & CPM: Introduction to Project Management, Activities, Events, Predecessor Relationships, AOA Diagram, Early Start, Early Finish, Late Start & Late Finish Times, Earliest Occurrence and Latest Occurrence of the Event, Total Float, Free Float, Independent Float

CPM- Deterministic Model- Critical Path, Crashing, Optimal Project Duration, Least Possible Project Duration

PERT- Probabilistic Model- Various types of Activity Time Estimates, Standard Deviation and Variance of the Activities and Projects, and Probability of Completing the Project within scheduled time

Learning Outcome & Suggested Student Activities:

At the end of this Unit, student will be able to represent any project in the form of a network and estimate the parameters like Project Completion Time, Project Costs, and Optimum Duration of the Project, Probabilities of completing Projects as per schedule etc by applying either CPM or PERT technique as per the suitability.

The following URL will lead us to a video lecture on this Unit

http://www.youtube.com/watch?feature=player_detailpage&v=H58TPQNr2kM

UNIT V

Dynamic Programming : Introduction – Bellman's Principle of Optimality – Applications of Dynamic Programming- Capital Budgeting Problem – Shortest Path Problem – Solution of Linear Programming Problem by DP

Replacement Models: Introduction –Types of Replacement Problem, Determination of Economic Life of an Asset, and Simple Probabilistic Model for Items which completely fail-Individual Replacement Model, Group Replacement Model.

Learning Outcome & Suggested Student Activities:

At the end of this Unit, the student will be aware of applying Dynamic Programming technique to solve the complex problems by breaking them into a series of sub-problems. The following URL contains a video lecture on Dynamic Programming and the students are advised to go through

http://www.youtube.com/watch?feature=player_detailpage&v=ug7O1ISZyg0

Further, the student will gain knowledge in different types of maintenance, failure patterns and the economic replacement policies which are very much important for the continuous functioning of machinery in an organization. The students may visit the following websites for better understanding of the subject.

http://www2.ensc.sfu.ca/undergrad/courses/ENSC201/Unit09/lecture9.html

http://pakaccountants.com/what-is-depreciated-replacement-cost/

Text Books:

1. *Operation Research, J.K.Sharma,MacMilan, 5th edition, 2013.*
2. *Introduction to Operations Research, H.A.Taha, PHI, 9th edition, 2013.*

Reference Books:

1. *Operations Research, Dr. C.Nadhamuni Reddy & Sri Gopal Krishna, Kurnool Publishers*
2. *Operations Research by R Panneerselvam, PHI, 2nd edition, 2012.*
3. *Operations Research, Wagner, PHI Publications , 2nd edition.*
4. *Operations Research, S.R.Yadav, A.K.Malik, Oxford, 2015*
5. *Operations Research, A.M.Natarajan,P.Balasubramani,A. Tamilarasi,Pearson Education, 8th edition, 2011.*

Web References:

http://www2.informs.org/Resources/
http://www.mit.edu/~orc/
http://www.ieor.columbia.edu/
http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm
http://www.wolfram.com/solutions/OperationsResearch/
http://nptel.iitm.ac.in/video.php?subjectId=112106134

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15A03602 DESIGN OF MACHINE MEMBERS– II

Course Objective:

To aware the student about basic concepts of curved beams with different cross sections, design of power transmission elements, understand the design concepts of various types of springs, various types of bearings and gears.

To know the students how to apply design concepts in designing of IC engine parts like Piston, cylinder, connecting rod and crank shaft.

UNIT I

DESIGN OF CURVED BEAMS: Stresses in curved beams, Expression for radius of neutral axis for rectangular, circular, trapezoidal and T-Section. Design of crane hooks, C –clamps.

DESIGN OF POWER TRANSMISSIONS SYSTEMS: Design of Flat belt drives, V-belt drives & rope drives. Selection of wire ropes, design procedure for chain drives.

Learning Outcome & Suggested Student Activities:

After completion of this unit students are able to design crane hooks, C-clamps and various belt, rope and chain drives. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of power transmission elements.

http://machinedesign.com/

http://www.youtube.com/watch?v=PEKfS2Q1WqM&list=PL3D4EECEFAA99D9BE&index=19

http://www.youtube.com/watch?v=nMsB6Soz4Hc&list=PL3D4EECEFAA99D9BE&index=30

UNIT II

DESIGN OF MECHANICAL SPRINGS: Stress and deflections of helical Springs- Springs for fatigue loading – Natural frequency of helical springs-Energy storage capacity- Helical Torsion springs- Design of leaf springs.

DESIGN OF POWER SCREWS: Design of screw- Square, ACME and Buttress screws- Efficiency of the screw. Design of compound screw, differential screw, ball screw- possible failures

Learning Outcome & Suggested Student Activities:

After completion of this unit, students are able to design helical sprigs for two wheel vehicle and laminated springs for trucks. Also students can apply design concepts in designing power screws. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of springs and power screws.

http://machinedesign.com/

http://www.youtube.com/watch?v=PEKfS2Q1WqM&list=PL3D4EECEFAA99D9BE&index=19

http://www.youtube.com/watch?v=46quOD7V- cQ&list=PL3D4EECEFAA99D9BE&index=28

UNIT III

DESIGN OF BEARINGS: Types of Journal bearings – Lubrication – bearing materials – journal bearing design – Ball and roller bearings – Static loading of ball & roller bearings, bearing life –Failure of bearings.

Learning Outcome & Suggested Student Activities:

After completion of this unit students are able to design journal bearings, ball bearings and roller bearings and to know the advantages of rolling contact bearings against sliding contact bearings. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of bearings.

http://machinedesign.com/

http://www.mae.ncsu.edu/klang/courses/mae442/Tranmission/Journal%20Bearing.ppt

http://nhbb.com/files/catalog_pages/HiTech_Catalog.pdf

UNIT IV

DESIGN OF SPUR & HELICAL GEARS: Spur gears- Helical gears – Bending strength – Design analysis of spur and Helical gears – Estimation of centre distance, module and face width. Check for dynamic and wear considerations.

Learning Outcome & Suggested Student Activities:

After completion of this unit students are able to design spur and helical gears for different input conditions. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of gears.

http://machinedesign.com/

http://nptel.iitm.ac.in/courses/IIT-MADRAS/Machine_Design_II/pdf/2_9.pdf

http://www.youtube.com/watch?v=8bml2pK6Ra0

UNIT V

DESIGN OF IC ENGINE PARTS: Pistons– Design of piston. Cylinder, Connecting Rod. Crank shafts- Center and over hung cranks.

Learning Outcome & Suggested Student Activities:

After completion of this unit students are able to know various forces acting on I C engine parts and failure criteria to be adopted for various parts. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of IC Engine parts.

http://machinedesign.com/

http://umpir.ump.edu.my/1778/1/Design_Of_Cooecting_Rod_Of_Internal_Combustion_Engine_A_Topology_Optimization_Approach.pdf

http://www.d-p.com.gr/pistons/piston-designs.html

Text Books:

1. *MechanicalEngineeringDesign,JosephE.Shigely,TMH Publishers,NewDelhi, 9th edition, 2010.*
2. *Machine Design, R.L. Norton, Tata McGraw Hill Publishers, 2nd edition, 2012.*

Reference Books:

1. *MachineDesign,Schaum'sseries,TMHPublishers, NewDelhi, 1st edition, 2011*
2. *Design ofMachine Elements, V.B.Bhandari , TMH Publishers,NewDelhi, 2nd edition, 2013.*
3. *MachineDesign,SadhuSingh,KhannaPublishers, NewDelhi*
4. *DesignofMachineElements,M.F.Spotts,PHIPublishers, NewDelhi.*
5. *MachineDesign,PandyaandShah,CharotarPublishers,Anand, 17th edition, 2012.*

NOTE: *Design data books are permitted in the examinations.*

Web References:

http://www.uni.edu/~rao/Md-17%20Shaft%20Design.pdf

http://www.uni.edu/~rao/Md-15%20Keys%20and%20Couplings.pdf

http://etidweb.tamu.edu/ftp/ENTC463/Notes/ENTC463Key%20and%20Coupling.pdf

http://www.science.howstuffworks.com/transport/engines.../bearing1.html

http://www.fi.edu/time/Journey/Time/Escapements/gearint.html

Suggestions:

1. students may visit nearby automobile workshops and machine tool shops to know about different machine elements like gears, bearings, springs, power screws, flexible drives and I C engine parts.

2. In addition to the text books students may also go through the reference books authored by V.B. Bhandari, by Pandya and Shah for more number of numerical problems.

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15A03603 HEAT TRANSFER

Course Objective:

The students will gain the ability to get an in-depth understanding of the principles governing the transfer of heat, the techniques , tools and skills required to solve typical thermal related problems, the analysis of energy flows in complicated systems and the design of efficient heat transfer equipments. Enables the student to utilize analogies to solve heat transfer problems. Further students gain hands-on experience in heat transfer experimentation through a number of laboratory tests.

UNIT I

Introduction: Modes and Mechanisms of Heat Transfer – Basic Laws of Heat Transfer – General Applications of Heat Transfer.

Conduction Heat Transfer: Fourier Rate Equation – General Heat Conduction Equation In Cartesian, Cylindrical and Spherical Coordinates.

Simplification and Forms of the Field Equation – Steady, Unsteady and Periodic Heat Transfer – Boundary and Initial Conditions.

One Dimensional Steady State Heat Conduction: In Homogeneous Slabs, Hollow Cylinders and Spheres – Overall Heat Transfer Coefficient – Electrical Analogy – Critical Radius/Thickness of Insulation – With Variable Thermal Conductivity – With Internal Heat Sources or Heat Generation

Learning Outcome & Suggested Student Activities:

After the completion of the unit, student can able to grasp the concept of steady state conduction. Student can learn representing conduction equation in various forms. Student can imply concept successfully to problems encounter in day to day life. The following URL's will be highly useful to students.

http://k12videos.mit.edu/content/heat-transfer;

http://www.youtube.com/watch?v=9WwSaIP5pbs

http://www.youtube.com/watch?v=HIYCR7gXXFo;

http://www.youtube.com/watch?v=S57nIs503fA

http://energy.concord.org/ir/experiments-page3.html

UNIT II

Heat Transfer in Extended Surface (Fins) – efficiency, effectiveness and temperature distribution on Long Fin, Fin with Insulated Tip and Short Fin, Application to Errors in Temperature Measurement.

One Dimensional Transient Heat Conduction: In Systems with Negligible Internal Resistance – Significance of Biot and Fourier Numbers – Chart Solutions of Transient Conduction Systems – Problems on Semi-infinite Body.

Learning Outcome & Suggested Student Activities:

After the completion of the chapter, student is expected understand the concept of extended surfaces and its applications. Also, student can aware transient heat conduction and how it vary w.r.t time. Student is expected to develop the ability to formulate practical conduction heat transfer problems by transforming the physical system into a Mathematical model and selecting an appropriate solution technique and evaluating the significance of results.

The following URLs will be highly useful to the students
http://www.youtube.com/watch?v=cMmREKOhIV8
http://www.youtube.com/watch?v=HiX7DKUlAOM

UNIT III

Convective Heat Transfer: Dimensional Analysis – Buckingham Π Theorem and Its Application for Developing Semi – Empirical Non-Dimensional Correlations for Convective Heat Transfer – Significance of Non-Dimensional Numbers – Concepts of Continuity, Momentum And Energy Equations.

Forced Convection: External Flows: Concepts of Hydrodynamic and Thermal Boundary Layer and Use of Empirical Correlations for Convective Heat Transfer for Flow Over – Flat Plates, Cylinders and Spheres.

Internal Flows: Division of Internal Flow through Concepts of Hydrodynamic and Thermal Entry Lengths – Use of Empirical Relations for Convective Heat Transfer in Horizontal Pipe Flow, Annular Flow.

Free Convection: Development of Hydrodynamic and Thermal Boundary Layer along a Vertical Plate – Use of Empirical Relations for Convective Heat Transfer on Plates and Cylinders in Horizontal and Vertical Orientation.

Learning outcome & Suggested Student Activities:

At the end of the chapter, Student will have the ability to formulate practical forced and natural convection heat transfer problems by transforming the physical system into a mathematical model, selecting an appropriate solution technique and evaluating the significance of results. Students will also demonstrate an ability to analyze the performance.

The following URLs will be highly useful to the students
http://www.youtube.com/watch?v=HIYCR7gXXFo
http://www.youtube.com/watch?v=S57nIs503fA;
http://energy.concord.org/ir/experiments-page3.html

UNIT IV

Heat Transfer with Phase Change:

Boiling: Pool Boiling – Regimes, Determination of Heat Transfer Coefficient in Nucleate Boiling, Critical Heat Flux and Film Boiling.

Condensation: Filmwise and Dropwise Condensation – Nusselt's Theory of Condensation on a Vertical Plate – Film Condensation on Vertical snd Horizontal Cylinders Using Empirical Correlations.

Heat Exchangers: Classification of Heat Exchangers – Overall Heat Transfer Coefficient and Fouling Factor – Concepts of LMTD and NTU Methods – Problems using LMTD And NTU Methods.

Learning outcome & Suggested Student Activities:

After the completion of the chapter, student will be able to calculate heat transfer in condensation and boiling systems, turbulent and laminar film condensation. Student can understand the concepts of critical heat flux and different models of critical heat flux. Student can able to grasp the fundamentals of heat exchangers and its analysis. The following URLs will be highly useful to the students to understand simple heat exchangers.

MIT: Professor Z. S. Spakovszky's Lecture Notes on Thermodynamics & Propulsion: "Section 18.5: Heat Exchangers" (HTML)

Lecture: YouTube: Stanford University: Professor Channing Robertson's Introduction to Chemical Engineering: "Lecture 12: Heat Exchangers"

http://www.youtube.com/watch?v=Gu1ApKpcxQc

UNIT V

Radiative Heat Transfer: Emission Characteristics and Laws of Black-Body Radiation – Irradiation – Total and Monochromatic Quantities– Laws of Planck, Wien, Kirchoff, Lambert, Stefan And Boltzmann – Heat Exchange Between Two Black Bodies – Concepts of Shape Factor – Emissivity – Heat Exchange Between Gray Bodies – Radiation Shields – Electrical Analogy for Radiation Networks.

Learning outcome & Suggested Student Activitie:

At the end of the unit, student can have knowledge on fundamental laws of radiative heat transfer. Also, student can understand the concept of radiative heat transfer between black bodies and grey bodies. Student can know radiation shields and their applications. Student can determine shape factor for different geometries and can know its importance in determining radiative heat transfer.

The following URLs will be highly useful to the students - http://energy.concord.org/ir/experiments-page5.html

Text Books:

1. *Fundamentals of Engg. Heat and Mass Transfer, R.C. Sachdeva, 4/e, New Age International, 2010.*

Reference Books:

1. *Heat Transfer, P.K.Nag, 3/e, TMH, 2011*
2. *Heat Transfer, S.P.Sukhatme, University Press, 4th edition, 2005*
3. *Heat Transfer, Holman.J.P, 10/e, TMH, 2012*
4. *Heat and Mass Transfer, R.K.Rajput, S.Chand& Company Ltd, 2001*
5. *Fundamentals of Heat and Mass Transfer, Kondandaraman, C.P., 3/e, New Age Publ.*
6. *Heat and Mass Transfer, D.K.Dixit, McGrawHill,2016*
7. *Thermal Engineering Data Book, B.S.Reddy and K.H.Reddy Rev/e, I.K. International, 2007*

NOTE: *Heat transfer Data books are permitted for Exam.*

Suggestion:

1. *Student is advised to visit heat transfer laboratory to understand the concept of three modes of heat transfer.*

Web References:

IIT video lecturers (NPTEL)
http://www.wisc-online.com/Objects/ViewObject.aspx?ID=SCE304
http://web.cecs.pdx.edu/~gerry/heatAnimations/sphereTransient/#TOC
http://rpaulsingh.com/animated%20figures/animationlisttopic.htm

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (ME)

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15A03604 FINITE ELEMENT METHODS

Course objective:

The subject should enable the students to learn the principles involved in discretization in finite element approach, form stiffness matrices and force vectors for simple elements, find the various approach followed in finite element approach, use the various elements for discretization and learn about shape functions.

To learn the application of FEM to various structural problems incorporating temperature.

and boundary conditions and heat transfer problems.

UNIT I

INTRODUCTION: Equilibrium equations in elasticity subjected to body force, traction forces and point loads, stress strain relations in 3D elasticity, plane stress and plane strain, Boundary conditions, Initial conditions. Governing equation for Steady state heat conduction with convective boundary conditions.

Approximate methods for solving the differential equations: Rayleigh-Ritz method, Weighted residual methods, Galerkin's method.

Integral formulation: Principle of a minimum potential energy, principle of virtual work, Generalized Finite element approach in solving these problems.

Solution methods for solving simultaneous equations.

Learning Outcome & Suggested Student Activities:

After completion of this unit students are able to know introductory basic principles and approaches for solving FEM problems in different fields. In addition to text books, the following URLs will be highly useful to the students to understand basic approaches to formulate and solving of FEM problems.

http://www.youtube.com/watch?v=NYiZQszx9cQ&list=PLA4CBD0C55B9C3878&index=1

http://www.youtube.com/watch?v=RQBXWF9b-Fs&list=PLA4CBD0C55B9C3878

UNIT II

Problems with One-dimensional geometry:

Bars: Formulation of stiffness matrix, Load vectors, Incorporation of boundary conditions: Elimination approach and penalty approach.

Trusses: Plane truss and space truss elements, Example problems involving plane truss elements. Examples involving multipoint constrains. Stress calculations.

Beams & Frames: Bending of beams, Interpolation functions, formulation of stiffness matrix and load vectors. Plane frames, space frames. Transformations of stiffness and load vectors.

Learning Outcome & Suggested Student Activities:

After completion of this unit students are able to formulate FEM model for simple problems. In addition to text books, the following URLs will be highly useful to the students to formulate FEM models for simple problems using different elements.

http://web.iitd.ac.in/~achawla/public_html/429/fem/overview.pdf

http://www.cmmacs.ernet.in/cmmacs/Lect_notes/sangeeta1.pdf

http://www.mecheng.iisc.ernet.in/~suresh/me237/fea/Chapter4.pdf

UNIT III

INTERPOLATION MODELS: Polynomial form of interpolation functions - linear, quadratic and cubic, simplex, complex, Multiplex elements, Selection of the order of the interpolation polynomial, Convergence requirements, 2D Pascal Triangle, Linear interpolation polynomials in terms of global coordinates for triangular (2D simplex) elements, Linear interpolation polynomials in terms of local coordinates for triangular (2D simplex) elements, quadrilateral element.

HIGHER ORDER AND ISOPARAMETRIC ELEMENTS: Lagrangian interpolation, Higher order one dimensional elements- quadratic, Cubic element and their shape functions, properties of shape functions, Shape functions of 2D quadratic triangular element in natural coordinates, 2D quadrilateral element shape functions – linear, quadratic, Biquadric rectangular element Tetrahedral and hexahedral elements.

Learning Outcome &Suggested Student Activities:

After completion of this unit students are able to write interpolation functions to higher order isoparametric elements. In addition to text books, the following URLs will be highly useful to the students to understand basic concepts of isoparametric elements.

http://www.kochmann.caltech.edu/ae108a/IsoparametricElements.pdf

http://www.me.mtu.edu/~bettig/MEEM4405/Lecture08.pdf

http://site.iugaza.edu.ps/marafa/files/FEM-Chapter-10.pdf

UNIT IV

FINITE ELEMENT APPLICATION IN SOLID MECHANICS:

Problem modeling and Finite element analysis in 2D plane elasticity with triangular and quadrilateral elements, Isoparametric, subparametric and superparametric elements. Interpolation, Jacobian, matrices relating strain and nodal displacements, stiffness matrix formulation, Consistent and lumped load vectors, Numerical integration Gaussian quadrate.

Axi-symmetric triangular elements: formulation of stiffness and load vectors.

Introduction to 3D stress analysis.

Learning Outcome &Suggested Student Activities:

After completion of this unit students are able to derive element matrices for applying the principles to find stresses in beams and trusses and temperature distribution in composite walls and fins. In addition to text books, the following URLs will be highly useful to the students to develop and solve FEM models using beam and truss elements.

http://www.youtube.com/watch?v=UeatU9OpDNA&list=PLA4CBD0C55B9C3878

http://uqu.edu.sa/files2/tiny_mce/plugins/filemanager/files/4041296/ComputerApplicationsInStructures/LeturesTutorialsDowloadedFromWeb/Lecture%202%20Truss%20and%20Beam%20FEM.pdf

http://www.engineering.uiowa.edu/~sxiao/class/058-153/lecture-24.pdf

www.rpi.edu/~des/CST.ppt

UNIT V

HEAT TRANSFER AND FLUID MECHANICS PROBLEMS:

Steady state heat conduction with convective and heat flux boundary conditions, Functional approach, Galerkin approach formulation of element characteristic matrices and vectors in 1D and 2D problems. Temperature distribution in composite walls one dimensional and two dimensional fins and extended surfaces.

Two dimensional potential flow problems: Potential function formulation and stream function formulation.

Learning Outcome & Suggested Student Activities:

After completion of this unit students are able to solve bars, trusses, beams and heat transfer problems using FEM and also to apply boundary conditions in realistic problems. In addition to text books, the following URLs will be highly useful to the students to develop and solve FEM models using different elements. The students are also advised to use FEM software to solve all application problems.

http://www.mecheng.iisc.ernet.in/~suresh/me237/fea/Chapter6.pdf

http://www.colorado.edu/engineering/cas/courses.d/IFEM.d/IFEM.Ch22.d/IFEM.Ch22.pdf

Text Books:

1. *Introduction to Finite Element in Engineering, TirupatiChandrapatla and Bellagundu ,*
   Pearson Education, New Delhi.
2. *Finite Element Methods, S. S. Rao , Pergamom Press, New York*

Reference Books:

1. *Finite Element Method by R. Dhanaraj, K. Prabhakaran Nair Oxford University Press*
2. *Introduction to FEM, J. N. Reddy, TMH Publishers, New Delhi.*
3. *Finite Element Analysis, C.S. Krishna Moorthy, TMH Publishers, New Delhi.*
4. *Fundamentals of Finite Element Analysis, David V. Hutton , TMH Publishers, New Delhi.*
5. *Introduction to the Finite Element Methods, Desai and Abel , CBS Publishers, New Delhi.*
6. *Finite and Boundary Methods in Engineering, O.P.Gupta, Oxford and IBH Publishers, New Delhi.*
7. *Finite Element Modeling for Stress Analysis, R. D. Cook, John. Wiley & Sons, 1995.*

WEB REFERENCES

1. *Finite Element Method IIT Kanpur Course, Prof. C.S. Upadhyay* http://nptel.iitm.ac.in/video.php?subjectId=112104115

2. *Computational Methods in Design and Manufacturing by Dr. R. Krishnakumar, Department of Mechanical Engineering, IIT Madras*
http://nptel.iitm.ac.in/video.php?subjectId=112106135

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (ME)

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15A03605 METAL FORMING PROCESSES

Course Objective:

Metal forming processes are highly non linear because they involve geometric, material and contact non linearity. And so this subject introduce the concepts of one, two and three dimensional stress analysis, theory of plasticity, strain hardening, hot and cold working process. The students also will get the awareness on various types of rolling mills, forgings, extrusions, wire drawing processes, sheet metal operations, concepts on plastic manufacturing processes and rapid manufacturing process and its applications.

UNIT 1

Stress, strain, Two dimensional stress analysis and three dimensional stress analysis, relation between engineering stress and true stress, relation between engineering strain and true strain, yield criteria, yield locus, theory of plasticity, Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth, Comparison of properties of Cold and Hot worked parts

Learning Outcome & Suggested Student Activities:

Students can understand the basic concept on one, two and three dimensional stress analysis, theory of plasticity, strain hardening, hot and cold working process. The students are advised to visit the URLs http://www.nptel.iitm.ac.in/iitkgp.ac.in, http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm.

UNIT II

ROLLING: Bulk deformation processes – Economics of bulk forming, principles and theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements, applications and, limitations, defects in rolled products – machinery and Equipment.

FORGING PROCESSES: Principles of forging –Types Forging – Smith forging, Drop Forging – Roll forging – Forging hammers: Rotary forging – forging defects, Forces in forging of strip, disc and power requirements, applications, Equipment and their selection.

Learning Outcome & Suggested Student Activities:

Students can understand the principles of rolling and forging processes, their applications and defects. The students are advised to visit URLs http://www.nptel.iitm.ac.in/iitkgp.ac.in, http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm

UNIT III

EXTRUSION PROCESSES: Basic extrusion process and its characteristics. Mechanics of hot and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion Hydrostatic extrusion, forces in extrusion of cylindrical and non cylindrical components – characteristics and defects in extruded parts.

Wire Drawing: Process Mechanics and its characteristics, determination of degree of drawing, drawing force, power, and number of stages-defects in products.

Learning Outcome & Suggested Student Activities:

Students can understand the fundamentals of extrusion process and wire drawing processes and their industrial applications. The students are advised to visit the URLs http://www.nptel.iitm.ac.in/iitkgp.ac.in, http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm.

UNIT IV

Sheet Metal Working – Economical Considerations - Stamping, forming and other cold working processes: Blanking and piercing – Bending and forming – Drawing and its types – Cup drawing and Tube drawing – coining – Hot and cold spinning. Force and power requirement in sheet metal operations, defects in sheet metal products – Equipment, tooling and their characteristics.

Learning Outcome &Suggested Student Activities:

Students can understand the various press working processes, their advantages and disadvantages. The students are advised to refer the text book Workshop Technology by H***ajra Choudhary. Students are advised to visit nearby sheet metal works industries.***

UNIT V

Processing of plastics, injection and blow moulding, calendaring, thermo forming, compression moulding, transfer moulding, High energy rate forming methods Rapid manufacturing: - Introduction – concepts of rapid manufacturing, information flow for rapid prototyping, classification of rapid prototyping process, sterer holography fused deposition modeling, selective laser sintering, Applications of rapid prototyping process

Learning Outcome &Suggested Student Activities:

Students can understand the concept of plastic manufacturing process, rapid manufacturing process and its applications. Students are advised to visit the following URLs http://www.nptel.iitm.ac.in/iitkgp.ac.in, http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm.

Text Books:

1. *Manufacturing Technology, Schmid and kalpakjin, Pearson Education.*
2. *Manufacturing Technology, Foundry forming and welding, Vol I , P.N. Rao,TMH*

Reference Books:

1. *Production Technology, R.K. Jain, Khanna Publishers,17th edition, 2012*
2. *Process and materials of manufacturing –Lindberg, PE*
3. *Principles of Metal Castings, Rosenthal.*
4. *Welding Process, Parmar*
5. *Manufacturing Technology, R.K. Rajput, Laxmi Pub*
6. *Rapid Prototyping Principles and Applications, RafiqNoorani, Wiely Pub.*

Web Resources:

www.casde.iitb.ac.in/store/events/2003/IAT-Pune.../DFMA.ppt
www.rose-hulman.edu/~stienstr/ME470/DFA.ppt
www.design4manufacturability.com/DFM_article.htm

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (ME)

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13A03606 NONCONVENTIONAL SOURCES OF ENERGY
(CBCC- I)

Course Objective:
To create awareness to the student about basic concepts of non-conventional source of energy, to understand the process of collection, storage, conversion and applications of Solar Energy, Wind Energy, Bio Mass, OTEC. To learn about direct conversion methods.

UNIT – I
PRINCIPLES OF SOLAR RADIATION: Role and potential of new and renewable source, the solarenergy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrialand terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT-II
SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT-III
SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, Sensible, latent heat andstratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.
WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

UNIT-IV
BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gasyield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.
GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy, potential inIndia.

UNIT-V
OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidaland wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, and principles of DEC.
Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects, Figure of merit, materials, applications,
MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator,
MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faraday's law's, thermodynamic aspects, selection of fuels and operating conditions.

Outcomes:

- *Understanding various Non-conventional sources of Energy.*
- *Able to learn how to use renewable energies instead of conventional fuels.*

TEXT BOOKS:

1. *Non-Conventional Energy Sources /G.D. Rai*
2. *Energy Resources Utilization and Technologies, Anjaneyulu Yerramilli, Francis Tuluri, BS Publications, 2012*

REFERENCES :

1. *Renewable Energy Sources/ Twidell & Weir*
2. *Non Conventional Energy Resources, B.H.Khan, McGrawHIll, 2015*
3. *Solar Power Engineering/B.S.Magal Frank Kreith & J.F.Kreith.*
4. *Principles of Solar Energy/ Frank Krieth & John F Kreider.*
5. *Non-Conventional Energy/ Ashok V Desai/ Wiley Eastern*

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15A03607 TOTAL QUALITY MANAGEMENT
(CBCC-I)

Course Objective:

To understand the concept of quality, cost of quality, international quality standards.
To learn the principles of Total quality management, techniques for problem solving.
To learn about various tools of quality management used in various industrial applications.

UNIT – I

TQM – overview , concepts, elements – History-Quality management philosophies-Juran, Deming, Crosby , Feigenbaum, Ishikawa– Stages of Evolution– continuous improvement
– objectives – internal and external customers.
Quality standards – Need of standardization - Institutions – bodies of standardization, ISO 9000 series – ISO 14000 series – other contemporary standards – ISO certification process-Third party audit.

UNIT – II

Process management- Quality measurement systems (QMS) – developing and implementing QMS – nonconformance database- TQM tools & techniques- 7 QC tools-7 New QC tools.
Problem Solving techniques - Problem Solving process – corrective action – order of precedence

UNIT – III

System failure analysis approach – flow chart – fault tree analysis – failure mode assessment and assignment matrix – organizing failure mode analysis – pedigree analysis.
Quality circles – organization – focus team approach – statistical process control – process chart – Ishikawa diagram – preparing and using control charts.

UNIT IV

Quality Function Development (QFD) – elements of QFD – benchmarking-Types-Advantages & limitations of benchmarking – Taguchi Analysis – loss function - Taguchi design of experiments. Poka-yoke, Kaizen, Deming cycle.

UNIT – V

Value improvement elements – value improvement assault – supplier teaming. Business process reengineering & elements of Supply chain management.
Six sigma approach – application of six sigma approach to various industrial situations.

Outcomes:

- *Understanding the concepts of TQM.*
- *Able to use tools and techniques for problem solving.*
- *To formulate quality circles to find solutions to problems in industry.*
- *Analyze various quality problems and contribute towards continuous improvement in the system.*

TEXT BOOKS:

1. Total Quality Management, D.R.Kiran, BS Publications, 2016
2. Total Quality Management by Besterfield, Pearson.

REFERENCE BOOKS:

1. Quality management by Howard Giltow-TMH
2. Quality management by Evans.
3. Quality management by Bedi
4. Total Quality Management by Joseph & Susan Berg
5. Total Quality Management-Toward the Emerging Paradigm, Bounds, Yorks, Adams, Ranney, McGraHill, 1994

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (ME)

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15A03608 MECHATRONICS
(CBCC- I)

Course Objective:

To make the students to learn about the Basic electronics, electrical and mechanical components used to control the machines and industries. Various types of sensors, signal conditioning systems and various pneumatic and hydraulic components used in control systems. Micro controllers, PLCS and PLC program and programmable motion control systems.

UNIT I

INTRODUCTION: Definition – Trends - Control Methods: Stand alone, PC Based (Real Time Operating Systems, Graphical User Interface, Simulation) - Applications: SPM, Robot, CNC, FMS, CIM.

Learning outcome &Suggested Student Activities:

This unit helps the students to understand the importance of mechatronicssubject and controlling the various machines, robots etc. Students may observe CNC machines in CAD/CAM lab to understand the mechatronics concepts.
Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 1, by the authors - W .Bolton, publishers - Pearson Education Press, 3rd edition, 2005.Students may refer the following website www.nptel.iitm.ac.in/ECE/mechatronicswww.ustudy.in/mech/mechs en.wikipedia.org /wiki/mechatronics for better understanding of this topic.

UNIT II

SIGNAL CONDITIONING: Introduction – Hardware - Digital I/O , Analog input – ADC , resolution , speed channels Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering.

Learning outcomes & Suggested Student Activities:

This unit helps the students to understand how to convert the analog signals into useful required form. These signal condition systems may be observed in electronics and communication engineering department labs.
Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter – 3, by the authors - W Bolton, publishers- Pearson Education Press, 3rd edition, 2005.
Students may refer the following website www.nptel.iitm.ac.in/ECE/mechatronicswww.saylor.org/corses/me302___for better understanding of this topic.

UNIT III

PRECISION MECHANICAL SYSTEMS: Pneumatic Actuation Systems - Electro-pneumatic Actuation Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts – Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Bearings- Motor / Drive Selection.

Learning outcome & Suggested Student Activities:

In this unit the students learn about the pneumatic and hydraulic systems and about some precisions mechanical component which are useful in the field of automation. This automation system can be observed in many processing industries and manufacturing industries to handle the materials and control the machines (or) process. Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter-5, 6 & 7 by the authors - W .Bolton, publishers - Pearson Education Press, 3rd edition, 2005.Students may refer the following website www.pic-design.com, www.sdp-si.com, www.csio.res.in,

UNIT IV

ELECTRONIC INTERFACE SUBSYSTEMS: Motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers, over current sensing, resettable fuses, Power Supply - Bipolar transistors/ mosfets.
ELECTROMECHANICAL DRIVES: Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - PWM's - Pulse Width Modulation – Variable Frequency Drives.

Learning outcome & Suggested Student Activities:

The objective of this unit is to make the student aware of electronic systems, electromechanical drives used in automation. Some of the systems may be observed electrical and electronics labs for better understanding. Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 7 by the authors – W. Bolton, publishers- Pearson Education Press, 3rd edition, 2005.Students may refer the following website www.pic-design.com, www.sdp-si.com, www.csio.res.info better understanding of this topic.

UNIT V

MICROCONTROLLERS OVERVIEW: 8051 Microcontroller , micro processor structure - Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors – Applications, Programming –Assembly.

PROGRAMMABLE LOGIC CONTROLLERS: Basic Structure - Programming: Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling -Analog input / output - PLC Selection, interface – R232 etc.,- Applications.

Learning outcome & Suggested Student Activities:

This unit helps the student to know about microcontrollers and to programming of programmable logic controls. Students may visit pharmaceutical industries, thermal power plants etc. To observe the PLC based control systems. to know about the interface between processing equipment and central system.

Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 15, 14 & 19 by the authors - W .Bolton, publishers- Pearson Education Press, 3rd edition, 2005.Students may refer the following website www.authorstream.com, www.atmel.in, www.lifehacker.com

Text Books:

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering , W Bolton, Pearson Education Press, 3rd edition, 2005.

2. Mechatronics, M.D.Singh, J.G.Joshi, PHI.

Reference Books:

1.Mechatronics Principles, concepts and applications. Nitaigour premchand mahalik, MC Graw Hill Edu.

2. Mechatronics Source Book, Newton C Braga, Thomson Publications, Chennai.

3. Mechatronics, N. Shanmugam, Anuradha Agencies Publisers.

4. Mechatronics System Design, Devdas shetty,Richard,Thomson.

5. Mechatronics Er. R.K. Rajput. S. Chand Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (ME)

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15A01608 INTELLECTUAL PROPERTY RIGHTS
(CBCC – I)

COURSE OBJECTIVE:

This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations.

UNIT – I

Introduction To Intellectual Property: Introduction, Types Of Intellectual Property, International Organizations, Agencies And Treaties, Importance Of Intellectual Property Rights.

UNIT – II

Trade Marks : Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.

UNIT – III

Law Of Copy Rights : Fundamental Of Copy Right Law, Originality Of Material, Rights Of Reproduction, Rights To Perform The Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice Of Copy Right, International Copy Right Law.
Law Of Patents : Foundation Of Patent Law, Patent Searching Process, Ownership Rights And Transfer

UNIT – IV

Trade Secrets : Trade Secrete Law, Determination Of Trade Secrete Status, Liability For Misappropriations Of Trade Secrets, Protection For Submission, Trade Secrete Litigation.
Unfair Competition : Misappropriation Right Of Publicity, False Advertising.

UNIT – V

New Developments Of Intellectual Property: New Developments In Trade Mark Law ; Copy Right Law, Patent Law, Intellectual Property Audits.
International Overview On Intellectual Property, International – Trade Mark Law, Copy Right Law, International Patent Law, International Development In Trade Secrets Law.

TEXT BOOKS & REFERENCES:

1. Intellectual Property Rights, Deborah. E. Bouchoux, Cengage Learing.
2. Intellectual Property Rights– Unleashmy The Knowledge Economy, Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,

Course Outcomes:

On completion of this course, the student will have an understanding of the following:

a) *Intellectual Property Rights and what they mean*
b) *Trade Marks and Patents and how to register them*
c) *Laws Protecting the Trade Marks and Patents*
d) *Copy Right and laws related to it.*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (ME)

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15A03609 HEAT TRANSFER LABORATORY

***NOTE**: Thermal Engineering data books are permitted in the examinations*

1. Thermal conductivity of insulating powder material through Concentric Sphere apparatus.
2. Thermal conductivity of insulating material through lagged pipe apparatus
3. Overall heat transfer co-efficient through Composite Slab Apparatus
4. Thermal Conductivity of metal (conductor).
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer coefficient in forced convection.
8. Heat transfer coefficient in natural convection
9. Experiment on Parallel and counter flow heat exchanger.
10. Emissivity of a gray body through Emissivity apparatus.
11. Experiment on Stefan Boltzman Apparatus.
12. Heat transfer in drop and film wise condensation.
13. Experiment on Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.
15. Study of Two – Phase flow.

***Note:** Any 10 of the above 15 experiments are to be conducted.*

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15A03610 COMPUTER AIDED ENGINEERING LAB (CAE LAB)

I. Introduction to Analysis Software Package

II. Structural analysis: (Any Six exercises)

1. Analysis of a rectangular plate with a hole.
2. Analysis of a truss member under loading.
3. Analysis of a bracket plate with axial loading
4. Analysis of a bracket plate with eccentric loading
5. Static Analysis of Prismatic bar
6. Static Analysis of a Corner Bracket
7. Static Analysis of beam
8. Analysis of Thermally Loaded support Structure
9. Analysis of Hinged support member
10. Analysis of Tapered plate under transverse load

III. Thermal analysis:(Any two exercises)

1. Analysis of a square plate considering conduction.
2. Analysis of a square plate considering conduction and convection.
3. Analysis of a compound bodies considering conduction and convection.

IV. Computational Fluid Dynamics (Any four exercises)

1. Determine the flow of incompressible gas through an S-bend for laminar flow.
2. Determine the flow of incompressible gas through an S-bend for turbulent flow.
3. Determine that of incompressible water flowing over a cylinder.
4. Determine air flow over a simple geometry (aerofoil) in a wind tunnel (2-D).
5. Determine heat transfer from the heated fin within a rectangular enclose containing air.
6. Determine how to solve a natural convection problem (in an infinitely long concentric cylinders).
7. Determine liquid enters through two inlets with different temperatures (multiphase flow) and leaves one outlet.

Software can be used: ANSYS, ALG Nastran, Star-CCM+, Fluent, FIRE. CFX.

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15A52602 ADVANCED ENGLISH LANGUAGE COMMUNICATION SKILLS (AELCS) LAB (Audit Course)

1. INTRODUCTION

With increased globalization and rapidly changing industry expectations, employers are looking for the wide cluster of skills to cater to the changing demand. The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information and to organise ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Taking part in social and professional communication.

2. OBJECTIVES:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.

3. SYLLABUS:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

UNIT-I: COMMUNICATION SKILLS

1. Reading Comprehension
2. Listening comprehension
3. Vocabulary Development
4. Common Errors

UNIT-II: WRITING SKILLS

1. Report writing
2. Resume Preparation
3. E-mail Writing

UNIT-III: PRESENTATION SKILLS

1. Oral presentation
2. Power point presentation
3. Poster presentation

UNIT-IV: GETTING READY FOR JOB

1. Debates
2. Group discussions
3. Job Interviews

UNIT-V: INTERPERSONAL SKILLS

1. Time Management
2. Problem Solving & Decision Making
3. Etiquettes

4. LEARNING OUTCOMES:

- Accomplishment of sound vocabulary and its proper use contextually
- Flair in Writing and felicity in written expression.
- Enhanced job prospects.
- Effective Speaking Abilities

5. MINIMUM REQUIREMENT:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infra-structural facilities to accommodate at least 60 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system

- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

6. SUGGESTED SOFTWARE:

The software consisting of the prescribed topics elaborated above should be procured and G

1. **Walden Infotech: Advanced English Communication Skills Lab**
2. **K-VAN SOLUTIONS-Advanced English Language Communication Skills lab**
3. **DELTA's key to the Next Generation TOEFL Test: Advanced Skills Practice.**
4. **TOEFL & GRE**(KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
5. **Train2success.com**

7. BOOKS RECOMMENDED:

1. **Objective English for Competitive Exams**, Hari Mohana Prasad, 4th edition, Tata Mc Graw Hill.
2. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, O U Press 3rd Edn. 2015.
3. **Essay Writing for Exams, Audrone Raskauskiene, Irena Ragaisience & Ramute Zemaitience,OUP, 2016**
4. **Soft Skills for Everyone,** Butterfield Jeff, Cengage Publications, 2011.
5. **Management Shapers Series** by Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. **Campus to Corporate,** Gangadhar Joshi, Sage Publications, 2015
7. **Communicative English,**E Suresh Kumar & P.Sreehari, Orient Blackswan, 2009.
8. **English for Success in Competitive Exams,** Philip Sunil Solomon OUP, 2015

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15A52601 MANAGEMENT SCIENCE

Course Objective*: The objective of the course is to equip the student the fundamental knowledge of management science and its application for effective management of human resource, materials and operation of an organization. It also aims to expose the students about the latest and contemporary developments in the field of management.*

UNIT –I

Introduction to Management: Concept-Nature and Importance of Management, Functions-Evaluation of Scientific Management, Modern management-Motivation Theories-Leadership Styles-Decision MakingProcess-Designing Organization Structure-Principles and Types of Organization.

UNIT- II

Operations Management: Plant location and Layout, Methods of production, Work-Study-Statistical Quality Control through Control Charts, Objectives of Inventory Management, Need for Inventory Control-EOQ&ABC Analysis(Simple Problems)**Marketing Management:**

Meaning,Nature, Functions of Marketing, Marketing Mix, Channels of distribution-Advertisement and sales promotion-Marketing strategies-Product Life Cycle.

UNIT –III

Human Resource Management(HRM): Significant and Basic functions of HRM-Human Resource Planning(HRP), Job evaluation, Recruitment and Selection, Placement and Induction-Wage and Salary administration. Employee Training and development-Methods-Performance Appraisal-Employee Grievances-techniques of handling Grievances.

UNIT –IV

Strategic Management: Vision, Mission, Goals and Strategy- Corporate Planning Process-Environmental Scanning-SWOT analysis-Different Steps in Strateg Formulation, Implementation and Evaluation. **Project Management**: Network Analysis-PERT, CPM, Identifying Critical Path-Probability-Project Cost Analysis, Project Crashing (Simple Problems).

UNIT-V

Contemporary Management Practices: Basic concepts of MIS-Materials Requirement Planning(MRP),Just-In-Time(JIT)System, Total Quality Management(TQM)-Six Sigma

and Capability Maturity Models(CMM) evies, Supply Chain Management, Enterprise Resource Planning(ERP),Performance Management, Business Process Outsourcing(BPO), Business Process Re-Engineering and Bench Marking, Balance Score Card.

Learning Outcome: This course enables the student to know the principles and applications of management knowledge and exposure to the latest developments in the field. This helps to take effective and efficient management decisions on physical and human resources of an organization. Beside the knowledge of Management Science facilitates for his/her personal and professional development.

TEXT BOOKS:

1. A.R Aryasri: Management Science, TMH, 2013
2. Kumar /Rao/Chalill 'Introduction to Management Science' Cengage, Delhi, 2012.

REFERENCE BOOKS:

1. A.K.Gupta "Engineering Management",S.CHAND, New Delhi, 2016.
2. Stoner, Freeman, Gilbert, Management, Pearson Education,New Delhi, 2012.
3. Kotler Philip & Keller Kevin Lane: Marketing Mangement , PHI,2013.
5. Koontz & Weihrich: Essentials of Management, 6/e, TMH, 2005.
6. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
7. Memoria & S.V.Gauker, Personnel Management, Himalaya, 25/e, 2005
8. Parnell: Strategic Management, Biztantra, 2003.
9. L.S.Srinath: PERT/CPM,Affiliated East-West Press, 2005.

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15A03701 AUTOMOBILE ENGINEERING

Course Objective:

The students acquires sufficient knowledge to classify Engines, Chassis, Fuel Supply Systems, Cooling Methods, Lubrication Methods, Ignition Systems, Generating Systems, Suspension Systems, transmission system, steering mechanism and braking methods.

The students get the working knowledge of assembly of various components of layout and of various electrical equipment of an automobile.

UNIT I

Introduction: Components of a Four Wheeler Automobile – Chassis and Body – Power Unit –Power Transmission – Rear Wheel Drive, Front Wheel Drive, Four Wheel Drive – Types of Automobile Engines, Engine Construction, Turbo Charging and Super Charging – Oil Filters, Oil Pumps – Crank Case Ventilation.

Learning outcome & Suggested Student Activities:

Student can understand the function of each and every component of an automobile. Student can understand the use of turbo charging and super charging. Students may refer the following website auto.howstuffworks.com, www.em.gov.au for better understanding of this topic.

UNIT II

Transmission System: Clutches- Principle- Types: Cone Clutch, Single Plate Clutch, Multi Plate Clutch, Magnetic and Centrifugal Clutches, Fluid Fly Wheel – Gear Box- Types: Sliding Mesh, Constant Mesh, Synchromesh, Epi-Cyclic, Over Drive, Torque Converter.

Propeller Shaft – Hotch – Kiss Drive, Torque Tube Drive, Universal Joint, Differential, Rear Axles.

Learning outcome & Suggested Activities:

Student can be able to grasp the knowledge on emission standards, emission control techniques and electrical systems. Student can identify thrust areas for carrying their dissertation in future. Students may refer the following website www.dec.ny.gov,www.studymode.com,www.ehow.com, www.automotiveservices.blogspot.com for better understanding of this topic.

UNIT III

Steering System: Steering Geometry – Camber, Castor, King Pin Rake, Combined Angle Toe-In, Center Point Steering. Types Of Steering Mechanism – Ackerman Steering Mechanism, Davis Steering Mechanism, Steering Gears – Types, Steering Linkages.

Learning outcome &Suggested Student Activities:

At the end of the unit, student can have broad knowledge on each and every component of transmission system of a automobile. Students may refer the following websites en-wikipedia.org/wiki/transmission, www.youtube.com, www.youtube.com, jalopink.com, www.geansandstuff.com for better understanding of this topic.

UNIT IV

Suspension System: Objects of Suspension Systems – Rigid Axle Suspension System, Torsion Bar, Shock Absorber, Independent Suspension System.

Braking System: Mechanical Brake System, Hydraulic Brake System, Pneumatic and Vacuum Brake Systems.

Learning outcome & Suggested Student Activities:

After the completion of the chapter, student can able to understand purpose and methods of steering systems and their applications. Students may refer the following website www.scribd.com, www.youtube.com,leemyles.com www.howcanworks.com, www.forza.se/sider/of/listton/bi/stein1.pdf for better understanding of this topic.

UNIT V

Emissions from Automobiles – Pollution Standards National and International – Pollution Control– Techniques – Multipoint Fuel Injection for SI Engines- Common Rail Diesel Injection, Emissions from Alternative Energy Sources– Hydrogen, Biomass, Alcohols, LPG, CNG - Their Merits And Demerits.

Electrical System: Charging Circuit, Generator, Current – Voltage Regulator – Starting System, Bendix Drive, Mechanism of Solenoid Switch, Lighting Systems, Horn, Wiper, Fuel Gauge – Oil Pressure Gauge, Engine Température Indicator.

Learning outcome & Suggested Student Activities:

At the end of the unit. Student can have ample knowledge on suspension system and braking system of an automobile.

Students may refer the following website www.youtube.com, www.howcanworks.com, www.forza.se/sider/of/listton/bi/stein1.pdf for better understanding of this topic.

Text Books:

1. *Automotive Mechanics – Vol. 1 & Vol. 2, Kirpal Singh, Standard Publishers Distributors, 13th edition, 2013.*
2. *Automobile Engineering , William Crouse, TMH, 10th edition, 2006.*

Reference Books:

1. *Automobile Engineering ,R.K.Rajput,Laxmi Pub, 1st edition, 2013.*
2. *Automobile Engineering ,K.K.Ramalingam/Scitech Pub, 2nd edition.*
3. *Automotive engines , Newton, Steeds & Garret.*

Books in Digital Libraray:

www.nptel.iitm.ac.in

Suggestions:

Student is requested to visit the research and development cell of Automobile manufacturing companies and A.R.A.I emission testing centers.
For better understanding of these systems students may visit the Automobile service centre and APSRTC workshop.

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15A03702 CAD/CAM

Course objective:

The objective of the this subject is to enable the students to understand and handle design problems in symmetric manner, gain practical experience in handling 2-D drafting and 3-D modeling software systems, apply CAD in real life applications, understand the concepts G and M codes and manual part programming and know the applications of CNC machines. Further the students will become familiar on principles of computer graphics, geometric modeling, NC and CNC machines, group technology and FMS.

UNIT I

Overview of CAD/CAM: Product cycle, CAD, CAM and CIM. CAD Tools, CAM Tools, Utilization in an Industrial Environment, Evaluation criteria. CAD standards, CAD data structure, Data base management systems.

Computer Graphics: Co-ordinate systems, Graphics package functions, 2D and 3D transformations, homogeneous transformations, clipping, hidden line / surface removal colour, shading.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the basic concepts Automation, components of CAD/CAM, input and output components of CAD, Steps involved in computer aided design.

UNIT II

Geometric Modeling: Representation techniques, Parametric and non parametric representation, various construction methods, wire frame modeling, synthetic curves and their representations, surface modeling, synthetics surfaces and their representations.

Solid modeling, solid representation, fundamentals, introduction to boundary representations, constructive solid geometry, analytical solid modeling.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the geometric model of the component in CAD technology of computer graphics. The techniques of raster technology, scan conversion, clipping, removal of hidden lines and hidden surfaces, color, shading and texture.

UNIT III

Numerical Control: NC, NC Modes, NC Elements, NC Machine tools and their structure, Machining centre, types and features. Controls in NC, CNC systems, DNC systems. Adaptive control machining systems, types of adaptive control.

CNC Part Programming: Fundamentals, NC word, NC Codes, canned cycles, cutter radius compensation, length compensation, computed assisted part programming using APT: Geometry statements, motion statements, post process statements, auxiliary statements, macro statement program for simple components.

Learning outcomes & Suggested Student Activities:

Geometric Modelling constitutes the most important and complex part in most of CDA software packages. Hence the students should focus on various requirements of information that are generated during geometric modeling stage, various types and its applications. Mathematical representations of curves used in geometric construction.

UNIT IV

Group Technology & FMS: Part Family, Classification and Coding, advantages & limitations, Group technology machine cells, benefits. FMS: Introduction, components of FMS, material handling systems, Computer control systems, advantages.

Computer Aided Quality Control: Terminology in Quality control, Inspection and testing, Contact inspection methods - optical and non optical, integration of CAQC with CAD and CIM

Learning outcome & Suggested Student Activities:

CNC has revolutionized the manufacturing automation. The flexibility of manufacturing achvied with the use of CNC and associated Technology. The students should aimed to understand the principle of NC, CNC , Machining Centre and various methods of part programming. The student is advised to visit manufacturing industry where the CNC machines are using and also interact with CNC programmer in industry.

UNIT V

Computer Aided Processes Planning: Retrieval type and Generative type, benefits, Machinability data systems, Computer generated time standards.

Computer integrated production planning: Capacity planning, shop floor control, MRP-I, MRP-II, CIMS benefits. Trends in Manufacturing systems: Concepts of Reconfigurable manufacturing, Sustainable manufacturing and lean manufacturing.

Learning outcomes & Suggested Student Activities:

Understanding the need of GT as a means of bringing the benefits of mass production to relatively smaller production. Understanding the need of computers in process planning and QC .Understanding the definition and concept of FMS, and its elements etc.

Text Books:

1. CAD/CAM, A Zimmers&P.Groover, PE, PHI
2. CAD/CAM-Principles and applications, P.N. Rao, TMH, 3rd edition, 2010

Reference Books:

1.Computer Aided Design & Manufacturing, Lalit Narayan/Mallikarjuna Rao/M.M.M.Sarcar.PHI(2015)
2.Automation, Production systems & Computer integrated Manufacturing ,Groover, P.E
3. CAD/CAM/CIM, Radhakrishnan and Subramaniah, New Age, 3rd edition, 2008
4. Principles of Computer Aided Design and Manufacturing, FaridAmirouche, Pearson
5. CAD/CAM Theory and Practice, R. Sivasubramaniam, TMH
6. Computer Aided Design and Manufacturing, K.Lalit Narayan , PHI, 2008.
7. Computer Aided Manufacturing, T.C. Chang, Pearson, 3rd edition, 2008
8. A text book of CAD/CAM, CSP Rao, Hitech Publ.

Web References:

http://www.cadcamfunda.com/cam_computer_aided_manufacturing
http://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-classnotes.pdf

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15A03703 METROLOGY AND MEASUREMENTS

Course objective:

Students will be able to understand the Limits and Fits, linear measurements and angular measurements, gauges, comparators, optical measuring methods, measurement of flatness and roughness of surface. And also learn about the screw thread and gear measuring methods, Alignment tests on machine tools.

Students will be able to understand various transducers to measure displacement like Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers and also learn about Calibration procedure, temperature and pressure calibration methods, the measurement of flow stress, strain measurements acceleration and vibration.

UNIT I

LIMITS, FITS and TOLERNCES : Introduction, Definitions, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard system – International Standard organization system for plain work.

LIMIT GAUGES and GAUGE DESIGN: Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle. Design of Go and No Go gauges.

COMPARATORS: Principle of Measurement with Mechanical, Optical, Electrical, Electronic, Pneumatic comparators and their uses.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the Limits, Fits and Tolerance. Indian standard system – International Standard organization system. He will know the principles of working of the most commonly used instruments for measuring linear and angular distances.

http://www.nptel.iitm.ac.in

http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv113-Page1.htm

UNIT II

LINEAR MEASUREMENT: Length standard, line and end & wavelength standards, slip gauges – calibration of the slip gauges, Dial indicator, micrometers, vernier height gauges.

MEASUREMENT OF ANGLES AND TAPERS: Different methods – Bevel protractor – angle gauges – spirit levels – sine bar – Sine plate, rollers and spheres used to determine the tapers.

FLATNESS MEASUREMENT: Measurement of flatness of surfaces – straight edges– surface plates – optical flat and auto collimators, interferometer and their uses.

Learning outcome & Suggested Student Activities:
After completion of this unit students are able to study the different types of Comparators, optical measuring instruments, flatness measurement methods and measuring methods of surface roughness. http://www.nptel.iitm.ac.in/and for notes, http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv113-Page1.htm

UNIT III

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surfacewaviness- Numerical assessment of surface finish – CLA, R.M.S Values – R_a , R_z values, Methods of measurement of surface finish-profilograph, Talysurf, BIS symbols for indication of surface finish.

SCREW THREAD MEASUREMENT: Elements of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch- profile thread gauges.

GEAR MEASUREMENT: Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch, pressure angle and tooth thickness.

MACHINE TOOL ALIGNMENT TESTS: Requirements of Machine Tool Alignment Tests, Alignment tests on lathe, milling and drilling machine tools. Preparation of acceptance charts.

Learning outcome & Suggested Student Activities:
After completion of this unit students are able to understand, Screw thread elements and measuring methods, Gear tooth profile measurement, CMM, Alignment tests on lathe, milling and drilling machine tools.

UNIT IV

MEASUREMENT OF DISPLACEMENT: Theory and construction of various transducers to measure displacement - Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

MEASUREMENT OF SPEED: Mechanical Tachometers - Electrical tachometers - Stroboscope, Noncontact type of tachometer .

STRESS & STRAIN MEASUREMENTS: Various types - electrical strain gauge - gauge factor - method of usage of resistance strain gauge for bending, compressive and tensile strains - usage for measuring torque, Strain gauge Rosettes.

MEASUREMENT OF ACCELERATION AND VIBRATION: Different simple instruments - Principles of Seismic instruments - Vibrometer and accelerometer.

Learning outcome & Suggested Student Activities:
After completion of this unit students are able to understand working of various instruments used for measuring for displacement, temperature and pressure.

UNIT V

MEASURMENT OF TEMPERATURE: Standards and calibration, thermal expansion methods, thermo electric sensors(thermocouples), Electrical Resistance sensors, Junction semiconductor sensors, Digital thermometers, Radiation methods.

MEASUREMENT OF PRESSURE AND SOUND: Standards and calibration, basic methods of pressure measurement, dead weight gauges and manometers, Elastic transducers, vibrating cylinder, resonant transducers, High and low pressure measurement, sound measurement.

MEASUREMENT OF FORCE, TORQUE,POWER: Standards and calibration, Basic methods of Force Measurement, Torque measurement on rotating shafts, shaft power measurement(dynamometers), Vibrating wire force transducers.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand working of various instruments used for measuring for flow, speed,stress,strain and Vibration.

Text Books:

(1) *Mechanical Measurements ,Beckwith, Marangoni, Linehard, PHI, PE*
(2) *Measurement systems: Application and design, Doeblin Earnest. O. Adaptation by Manik and Dhanesh, TMH,2012.*
(3) *Engineering Metrology, R.K. Jain, Khanna Publishers, 20th edition, 2013.*

Reference Books:

(1) *Engineering Metrology, Mahajan, DhanpatRai, 2nd edition, 2013.*
(2) *BIS standards on Limits & Fits*
(3) *Fundamentals of Dimensional Metrology,Connie Dn ,CENGAGE LEARNERS*
(4) *Metrology & Measurement by Anand K Bewoor, vinay A kulkarni, Mc GrawHill, 2013.*
(5) *Instrumentation, measurement &analysis ,B.C.Nakra&KKChoudhary, TMH, 6th edition, 2011.*

Web References:

http://emtool box.nist.gov
CambridgeViscosity.com/Viscometer
www.e.FlukeCal.com/Calibration
www.inscotemperature.com/
www.solartronmetrology.com/

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15A03704 REFRIGERATION AND AIR CONDITIONING
(CBCC- II)

Course Objective:
This subject provides insights in how thermodynamic principles are applied within the refrigeration and air conditioning industry. It gives details on how different components work and influence each other. Students will learn how real systems used in commercial , industrial refrigeration and air conditioning industries are built-up.
The objective this subject is to make the student to have complete knowledge on various refrigeration methods like VCR, VAR and latest developments, knowledge on various air conditioning methods like summer, winter and year round air conditioning and to make the student to understand the practical applications of refrigeration and air conditioning systems.

UNIT I

Introduction to Refrigeration: Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit of Refrigeration, COP, EER, Different Refrigeration Methods

Air Refrigeration: Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems -Numerical Problems – Refrigeration Needs of Air Crafts.

Learning Outcome & Suggested Student Activities:
At the end of the chapter, student can able to understand the terminologies associated with refrigeration and also understand the basic principles of Refrigeration and applications. Student can also know the aspects of various natural refrigeration methods; understand the components of Air refrigeration system and the necessity of air craft refrigeration.
The following URLs are very useful to the students
http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20%20 Lecture%201.pdf
http://www.ignou.ac.in/upload/Unit%201-32.pdf ,
http:/nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20 Cond/pdf/RAC%20 Lecture%209.pdf

UNIT II

Vapour Compression Refrigeration (VCR) System – Basic Cycle - Working Principle and Essential Components of The Plant – COP – Representation of Cycle On T-S and P-h Charts – Expander Vs. Throttling, Effect of Sub Cooling and Super Heating – Cycle

Analysis – Actual Cycle- Influence of Various Parameters on System Performance – Construction and Use of P-h Charts – Numerical Problems.

Refrigerants – Desirable Properties – Classification of Refrigerants Used – Nomenclature- Secondary Refrigerants- Lubricants – Ozone Depletion – Global Warming- Newer Refrigerants.

Learning Outcome & Suggested Student Activities:

After the completion of the chapter, student can know the purpose and function of each of the components in the domestic refrigerator, analyzing the concepts of sub-cooling and super heating to improve the COP and also necessity of replacements for CFCs and HCFCs with new refrigerants.Following URLs are highly useful to the students

http://www.nptel.iitm.ac.in/courses/IITMADRAS/Applied_Thermodynamics/Module_6/6_Simple_Vapor_Compression_RS.pdf

http://www.mcquay.com/mcquaybiz/literature/lit_ch_wc/AppGuide/AG31-007.pdf

UNIT III

Vapor Absorption Refrigeration (VAR) System – Description and Working of NH_3 – Water System and Li Br –Water (Two Shell & Four Shell) System -Calculation of Max COP, Principle of Operation of Three Fluid Absorption System.

Steam Jet Refrigeration System: Working Principle and Basic Components-Estimation of Motive Steam Required, Principle and Operation of: (I) Thermo-Electric Refrigerator (Ii) Vortex Tube OrHilsch Tube.

Learning Outcome & Suggested Student Activities:

After the completion of the chapter, student can know the purpose and function of each of the basic components of the absorption refrigeration system. Student can have knowledge on latest developments of Electrolux, thermo electric vortex tube methods. Following URLs are highly useful to the students

http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20Lecture%2014.pdf

http://en.wikipedia.org/wiki/Thermoelectric_cooling

UNIT IV

Introduction to Air Conditioning: Psychrometric Properties & Processes – Characterization of Sensible and Latent Heat Loads — Need For Ventilation, Consideration of Infiltrated Air – Heat Load Concepts.

Air Conditioning Systems: Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.

Learning Outcome & Suggested Student Activities:

After the end of the chapter, student can have knowledge on the use of psychrometric terms in Air conditioning. Student can learn the use of psychrometric chart to know psychrometric properties of air. Student can able to understand the terms sensible heat load and latent heat load. This technical information is fundamental to all types of

domestic, commercial and industrial systems for the calculations of heat loads.
Student is advised to conduct experiment on A.C tutor in the laboratory. Following URLs are highly useful to the students
http://server.fst.uga.edu/kerr/FDST%204060/pdf%20files/7%20Psychrometrics.pdf
http://people.eng.unimelb.edu.au/mjbrear/436-432/chapter%208%20-%20psychrometry.pdf
http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2031.pdf

UNIT V

Air Conditioning Equipment - Humidifiers – Dehumidifiers – Air Filters, Fans and Blowers.

Human Comfort: Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart.Heat Pump – Heat Sources – Different Heat Pump Circuits.

Learning Outcome & Suggested Student Activities:

After the completion of the chapter, student can understand the components of A/C system and describe the cooling equipment combinations. Student can describe the concept of human comfort chart and the processes by which the body produces and rejects heat. Student can be familiar with the Heat pump circuit analysis. Following URLs are highly useful to the students
Effective temp- http://nptel.iitm.ac.in/courses/Webcourse contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2029.pdf
http://courses.washington.edu/me333afe/Comfort_Health.pdf
http://web.me.unr.edu/me372/Spring2001/Heat%20Pumps.pdf

Text Books:

1. *Refrigeration and Air Conditioning ,CP Arora,TMH, 15th edition, 2013.*
2. *A Course in Refrigeration and Air conditioning,S.CArora&Domkundwar, Dhanpatrai*

Reference Books:

1. *Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2nd edition, 2013*
2. *Principles of Refrigeration - Dossat / Pearson Education, 4th edition, 2007.*
3. *Refrigeration and Air Conditioning-P.L.Ballaney, 2nd edition, 2012.*
4. *Basic Refrigeration and Air-Conditioning – P.N.Ananthanarayanan / TMH, 4th edition, 2013.*

NOTE: *Tables/Codes: Thermal Engineering Data Book containingRéfrigérant and Psychrometric property Tables and charts are permitted in Exam*

Suggestions:

The entire syllabus is covered in the text book –" A Course in Refrigeration and Air conditioning " by Domkundwar, Arora, Dhanpatrai Publications (Highly useful book for GATE exam and other Government /Private sector competitive examinations)

Students can visit the nearby small scale Industries like Ice Plants to understand the principles of production of Ice and to observe the other simple components for practical understanding. Student is also advised to visit domestic refrigerator manufacturing industries/ Centralized and Split A/C system units.

Students are advised to watch the video lectures in the website - ***http://nptel.iitm.ac.in***

The fundamental concepts of Thermodynamics, Psychrometrics etc., are required for better understanding of this subject.

Web Resources:

http://www.refrigerationbasics.com/index.htm http://www.howstuffworks.com/ac.htm
http://www.ashrae.org
http://www.taftan.com/thermodynamics/AIRCOND.HTM
http://www.wisegeek.com/how-does-air-conditioning-work.htm

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech IV-I Sem. (ME)

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15A03705 TOOL DESIGN
(CBCC- II)

Course Objective:
To make the students to understand the design of single point cutting tool.
To learn about the design of drilling tool, tool wear Machinability index and tool life.
To make the students to understand jigs and fixtures, design principle of jigs and fixtures, locating and clamping principles.
To learn about the sheet metal operations, Design forming ,drawings ,Bending and drawing dies, forming dies.
To make the students to understand plastics commonly used as tooling material.

UNIT I

Tool materials: Ferrous, non ferrous, materials, heat treatment, plastics Classification of moulds used in processing of plastics, Design of injection, blow, and compression moulds.

Learning outcome &Suggested Student Activities:
After completion of this unit, students are able to understand the fundamentals of plastics as tooling materials, processing of plastics for tooling materials, heat treatment of materials, ferrous, nonferrous, non metallic, tooling materials.

UNIT II

Design of single point cutting tools: Single point, cutting tools-various systems of specifications, geometry and their interrelation, theories of formation of chip and their effect.

Learning outcome & Suggested Student Activities:
After completion of this unit students are able to understand single point cutting tool geometry and its design theory of chip formation.

UNIT III

Design of multipoint cutting tools: Drill geometry, Design of Drills, Rake & Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, milling cutters, cutting speeds and feed-machining times-design-form cutters, combination tools, reamers etc.

Learning outcome & Suggested Student Activities:
After completion of this unit students are able to understand the drilling tool geometry and its design. Tool life, machinability and tool wear.

UNIT IV

Design of jigs and fixtures: Basic principles of location and clamping, locating, methods and devices, jigs, definitions, types, general consideration in the design of jigs, drills bushing, methods of construction, fixtures-vice fixtures milling, boring, and lathe grinding fixtures.

Learning outcome &Suggested Student Activities:

After completion of this unit students are able to understand the design of Jigs and fixtures and advantages and disadvantages of Jigs and fixtures, types of Jigs & Fixtures – Principles of location and clamping. Some examples of jigs and fixtures.

UNIT V

Design of sheet metal blanking and piercing: Fundamentals of die cutting operating, power press- types, General press information, Material handling equipment, cutting action in punch and die operation. Die clearance, and types of Die construction. Die design fundamentals-blanking and piercing die construction, pilots, striper and pressure pads presswork material, strip layout.

Design of sheet metal bending, forming and drawings die: Bending dies, drawing dies, forming dies, drawing operations, variables that effect metal flow during drawing. Determination of blank size, drawing force, single and double action draw dies.

Learning outcome &Suggested Student Activities:

After completion of this unit students are able to understand the press working operations like punching, blanking, bending, drawing and forming, types of power presses, design of die, strip layout

Text Books:

1. Tool Design, Donaldson, Lecain and Goold, Tata McGraw Hill, 4th edition, 2012.
2. Principles of Metal cutting, A Bhattacharya, New Central Book Agency, Calcutta
3. ASTME Hand book on Tool Design.

Reference Books:

1. *Production Engineering Design (Tool Design) , SurendraKenav and Umesh 'Chandra,*
   Satyaprakashan, New Delhi 1994..
2. *Design of cutting Tools. Use of Metal Cutting Theory. ASTME publication Michigan USA, 1969.Amitabha Battacharya*

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15A03706 MODERN MANUFACTURING METHODS
(CBCC- II)

UNIT I

Need for Modern Manufacturing Methods: Non-traditional machining methods and rapid prototyping
methods - their relevance for precision and lean manufacturing.
Classification of non-traditional processes - their selection for processing of different materials and the range of applications.
Introduction to rapid prototyping - Classification of rapid prototyping methods - sterolithography, fused deposition methods - materials, principle of prototyping and various applications.

UNIT II

Ultrasonic machining – Elements of the process, mechanics of material removal, process parameters,
applications and limitations.
Abrasive jet, Water jet and abrasive water jet machining: Basic mechanics of material removal,
descriptive of equipment, process variables, applications and limitations.

UNIT III

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, metal removal rate in ECM, Tooling, process variables, applications, economic aspects of ECM.
Chemical Machining: Fundamentals of chemical machining- Principle of material removal- maskants – etchants- process variables, advantages and applications.

UNIT IV

Thermal Metal Removal Processes: Basic principle of spark erosion (EDM), Wire cut EDM, and Electric Discharge Grinding processes - Mechanics of machining, process parameters, selection of tool electrode and dielectric fluids, choice of parameters for improved surface finish and machining accuracy -
Applications of different processes and their limitations.
Plasma Machining: Principle of material removal, description of process and equipment, process
variables, scope of applications and the process limitations.

UNIT V

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes - process mechanics, parameters, applications and limitations. Laser Beam Machining: Process description, Mechanism of material removal, process parameters, capabilities and limitations, features of machining, applications and limitations.

Text Books:

1. Advanced machining processes, VK Jain, Allied publishers.
2. Manufacturing processes for engineering materials by Serope Kalpakjian and Steven R Schmid,
5edn, Pearson Pub.

Reference Books:

1. New Technology , Bhattacharya A, The Institution of Engineers, India 1984
2. Manufacturing Technology, Kalpakzian,Pearson
3. Modern Machining Process , Pandey P.C. and Shah H.S., TMH.

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B. Tech IV-I Sem. (ME)

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15A03707 COMPUTATIONAL FLUID DYNAMICS
(CBCC- III)

Course Objective:
This course covers topics related to Computational Fluid Dynamics (CFD). CFD is an important tool in engineering analysis and design of fluid systems. In this course Students will develop the equations describing fluid flow and numerical solutions to these equations. Emphasis will be placed on understanding different approaches employed for both time and spatial discretization and how to evaluate these approaches. Students will look at time accurate and steady-state methods, explicit and implicit techniques, laminar and turbulent flow, compressible and incompressible approaches, stability considerations, etc. These techniques will be applied to applications of mixing and heat transfer.

UNIT I

INTRODUCTION: Methods to solve a physical problem , numerical methods , brief comparison between FDM, FEM & FVM, applied numerical methods. Solution of a system of simultaneous linear algebraic equations, Iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for baned matrices. Finite difference applications in heat conduction and convention, heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer.

Learning outcome &Suggested Student Activities:
This chapter gives the overall view of the various kinds of numerical methods adopted. It also discusses about various solutions for the numerical methods adopted in CFD. The applications of finite difference methods with examples in conduction and convective heat transfer are introduced.

UNIT II

FINITE DIFFERENCES: Discretization, consistency, stability, and fundamentals of fluid flow modeling. Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

Learning outcome &Suggested Student Activities:
This chapter gives how to descretize partial differential equations, including the governing flow equations which is the foundation for the finite difference method. Explicit and implicit approaches represent the fundamental distinction between various numerical techniques.

UNIT III

ERRORS AND STABILITY ANALYSIS: introduction, first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme.

REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER: Introduction, Conservation of mass Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier stokes equations.

Learning outcome &Suggested Student Activities:

This chapter focuses on numerical errors that are generated and how the numerical calculations become unstable and also entails the conservations of mass, momentum and energy equations to the fluid flow along with Navier stokes equation.

UNIT IV

STEADY FLOW: Dimensions form of momentum and energy equations, navier stokes equation, and conservative body force fields, stream function, vorticity formulation, boundary, layer theory, buoyancy, driven convection and stability.

Learning outcome &Suggested Student Activities:

This unit gives the fundamental principles of fluid mechanics, its governing differential equations and boundary conditions.

UNIT V

SIMPLE CFD TECHNIQUES: Viscous flows conservation form space marching, relovation techniques, viscous flows, conservation from space marching relovation techniques, artificial viscosity, the alternating direction implicit techniques, pressure correction technique, computer graphic techniques used in CFD. Quasi one dimensional flow through a nozzle, turbulence models, standard and high reynolds number models and their applications.

Learning outcome & Suggested Student Activities:

This unit gives the information about some techniques for numerical solutions for flow problems. These equations are applicable to time and space marching solutions especially parabolic hyperbolic and elliptic equations.

Text Books:

1. *Computational Fluid Dynamics, J Chung (2010), 2nd edition, Cambridge University Press, India.*
2. *Computational Fluid Dynamics, John .D. Anderson (2010), 3rd edition, McGraw- Hill International Edition, India.*

Reference Books:

1. *Computational Fluid Mechanics and Heat Transfer, Ronnie Anderson, 3rd edition, CRC Press, Special Indian Edition.*
2. *Computational aerodynamics and fluid dynamics an introduction, Jean-Jacques Chattot (2010),3rd edition, Springer, Germany.*
3. *Essential computational fluid Dynamics – olegzikanov, wiley India.*
4. *Introduction to computational fluid dynamics – pradip, Niyogi S.K. Chakrabary, M.K. Laha – pearson.*

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B. Tech IV-I Sem. (ME)

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15A03708 AUTOMATION AND ROBOTICS
(CBCC- III)

Course Objective:
The subject should enable the students to understand the principles of automation, importance of automated flow lines and its types.
To learn the concepts of Robotics, kinematics of robot, principles of robot drives and controls, sensors used in robots and programming methods.

UNIT I

Introduction to Automation: Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation.

Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

Learning outcome & Suggested Student Activities:
After completion of this unit students are able to understand to know what is automation, types of automation, components of automation, strategies and levels of automation. Student is advised to visit URLs http://www.nptel.iitm.ac.in/and iitb.ac.in , http://www.learnerstv.com/video/Free-video-Lecture-30103-Engineering.htm for video lectures.

UNIT II

Automated flow lines: Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage.

Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

Learning outcome & Suggested Student Activities:
After completion of this unit students are able to understand the types of flow lines, quantitative analysis of flow lines, how the assembly is carried out on automated flow line without interruption and how to balance the line and flexible assembly lines. Student is advised to visit URLs
http://www.nptel.iitm.ac.in/and iitb.ac.in,
http://www.learnerstv.com/video/Free-video-Lecture-30103-Engineering.htm for video lectures.

UNIT III

Introduction to Industrial Robotics: Classification of Robot Configurations, functional line diagram, degrees of freedom. Components common types of arms, joints grippers, factors to be considered in the design of grippers.

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.

Learning outcome & Suggested Student Activities:

Student should come to know the various components in the anatomy of robot. By knowing this the student may apply in the design of new robotic structure. Student is advised to visit URLs

http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm

UNIT IV

Manipulator Kinematics: Homogenous transformations as applicable to rotation and transition - D-H notation, Forward inverse kinematics.

Robot actuators and Feedback components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the applications of various types of end effectors, and sensor devices. Student should also learn about the homogeneous transformations and its applications in the analysis of a robotic structure and method of developing different types of mechanisms and kinematics of the robot. Student is advised to visit URLs http://www.nptel.iitm.ac.in , http://www .iitb.ac.in , http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm

UNIT V

Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton - Euler formations. Trajectory Planning: Trajectory Planning and avoidance of obstacles path planning, skew motion, joint integrated motion - straight line motion.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand robot programming languages which may adopt in different applications of robot. Student also knows the control motion mechanism in all devices of robot and application of robots in manufacturing sector. Student is advised to visit URLs http://www.nptel.iitm.ac.in/and iitb.ac.in, http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm

Text Books:

1. *Automation , Production systems and CIM,M.P. Groover/Pearson Edu.*
2. *Industrial Robotics - M.P. Groover, TMH.*

Reference Books:

1. *Robotics , Fu K S, McGraw Hill, 4th edition, 2010.*
2. *An Introduction to Robot Technology, P. Coiffet and M. Chaironze, Kogam Page Ltd. 1983 London.*
3. *Robotic Engineering , Richard D. Klafter, Prentice Hall*
4. *Robotics, Fundamental Concepts and analysis – AshitaveGhosal,Oxford Press, 1/e, 2006*
5. *Robotics and Control , Mittal R K &Nagrath I J , TMH.*
6. *Introduction to Robotics – John J. Craig,PearsonEdu*

Web References:

http://www.cadcamfunda.com/cam_computer_aided_manufacturing
http://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-classnotes.pdf
http://nptel.iitm.ac.in/courses.php?branch=Mechanical
http://academicearth.org/courses/introduction-to-roboticsVideo references:-http://nptel.iitm.ac.in/video.php?courseId=1052

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B. Tech IV-I Sem. (ME)

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15A03709 PRODUCTION AND OPERATIONS MANAGEMENT
(CBCC- III)

Course Objective:
To make the students understand the functions of production planning & controls, generating of new products, issues in product design and strategies of aggregate planning. To provide the knowledge on principles of forecasting, forecasting methods, types and its accuracy. To provide the knowledge on facilities location, various types layouts and assembly line balancing. To provide the knowledge on lean management, concepts of JIT, six sigma, quality control, MRP,ERP and LOB.
To make the students understand the inventory management and scheduling techniques.

UNIT I

Functions of Production Planning & Controls operations & productivity, productivity measurement, Design of goods and services: selection, generating new products, product development, issues in product design.
Strategies for aggregates planning, aggregate planning using O.R. Models, Chase planning, Expediting, controlling aspects.

Learning Outcome & Suggested Student Activities:
At the end of this unit students can get the concepts on Production planning & controls operations and its functions, productivity and productivity measurements, design of goods and services and aggregate planning. Students are advised to visit following URLs http://www.nptel.iitm.ac.in/courses/IIT-MADRAS/Management_Science_II/Pdf/3_5.pdf. And also well documented note is available in pdf form at the following links.
www.processprotocol.com/extranet/doucuments/pdf/.../production1.pdf
elearning.dbhosting.net/.../Production%20Planning%20And%20Control
http://www.academicearth.org/lectures/product-development-process-observation

UNIT II

Forecasting – Importance of forecasting – Types of forecasting, their uses – General Principles of forecasting – Forecasting techniques – qualitative methods and quantitive methods – accuracy of forecasting methods. Scheduling Policies – Techniques, flow shop and job shop Scheduling techniques.

Learning Outcome & Suggested Student Activities:
Students can understand the importance of forecasting, uses of long term and short term forecasting and application of qualitative and quantitative methods for finding the future demands. Students are advised to refer the text book Forecasting: Methods and Applications Spyros G. Makridakis, Steven C. Wheelwright , Rob J Hyndman. For video lectures advised to visit following URLs http://www.learnerstv.com/video/Free-video-Lecture-2496-Management.htm; http://www.slideshare.net/jrdn_27/qualitative-and-quantitative-methods-of-research

UNIT III

Factors affecting facilities location, mathematical models for facilities, location, Types of facilities- layout: product layout, process layout, group technology layout, Assembly line balancing, computerized layout: ALDEP, CRAFT, CORELAP.

Learning Outcome & Suggested Student Activities:
At the end of the unit the student will be able to understand where the plant is to be located based on facilities available and what are the important factors affecting the facilities location of a plant, and plant layout. And also able to understand plant layout design to facilitate material flow and processing of a product in the most efficient manner through the shortest possible time. Can compare the rural & urban sites, methods of selection. The following URLs are useful to the students
http://www.slideshare.net/satya4/plant-layout-16143741
http://freevideolectures.com/Course/2371/Project-and-Production-Management/32
http://www.tcyonline.com/video-tutorials-computerised-layout-planning/101568

UNIT IV

Lean Management, philosophy and creation of lean enterprise, JIT concepts-Kanban System-Elements of total quality management, Six Sigma Quality Control.
MRP, –lot sizing techniques in MRP, introduction to ERP, LOB (Line of Balance).

Learning Outcome & Suggested Student Activities:
Students can understand the how philosophy of lean management applied to develop lean enterprise and basic concepts JIT, Six sigma control etc., Students are advised to visit the following URLs .http://www.learnerstv.com/video/Free-video-Lecture-6944-Management.htm; http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-852j-integrating-the-lean-enterprise-fall-2005/lecture-notes/
http://freevideolectures.com/Course/2688/Human-Resource-Management/13

UNIT V

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – various models Simple Problems.

Learning Outcome & Suggested Student Activities:

At the end of the unit the student will be able to understand the scheduling policies, flow shop and job shop scheduling techniques and concepts of Inventory, Classification, Functions, it's associated costs etc., and also able to recognize the importance of Inventory control to ensure their availability with minimum capital lock up. The following URLs are useful to the students.

http://www.technologyevaluation.com/search/for/inventory-management-pdf.html

http://freevideolectures.com/Course/3096/Operations-and-Supply-Chain-Management/10

Text Books:

1. Production and Operations Management, Ajay K Garg, McGrawHill, 2015

2. Operation Management by B. Mahadevan,PearsonEdu.

3. Operation and O.M by Adam & Ebert- PHI Pub.,

Reference Books:

1. Operations Management – S.N. Chary.

2. Modern Production , Operations Management , Baffa&Rakesh Sarin.

3. Production Control A Quantitative Approach , John E. Biegel.

4. Production Control , Moore.

5. Operations Management , Joseph Monks.

6. Operation Management by Jay Heizar& Read new Pearson

7. Elements of Production Planning and Control, Samuel Eilon.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech IV-I Sem. (ME)

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15A03710 CAD/CAM LABORATORY

LIST OF EXPERIMENTS:

I. 2D Drafting using Auto CAD or any drafting package

II. 3D Modeling :

1. Modeling of Component in 3D – V block
2. Modeling of Component in 3D – Open Bearing
3. Modeling of Component in 3D – Angular block
4. Modeling of Component in 3D – Dovetail Guide
5. Modeling of Component in 3D – Dovetail Bracket
6. Modeling of Component in 3D – Tool post

Geometric Modeling may be done Using Auto CAD or Pro-E or CATIA or Solid Works or Iron CAD

III. Assembly Modeling:

1. Assembly of a screw jack parts
2. Assembly of a knuckle joint
3. Assembly of a Oldham's coupling
4. Assembly of a footstep bearing
5. Assembly of a stuffing box
6. Assembly of a square tool post

IV. Machining of Simple Components on CNC Lathe and CNC Milling Machine.

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15A03711 METROLOGY & MEASUREMENTS LABORATORY

Any 6 experiments from each section

Section A:

1. Measurement of bores by internal micrometers and dial bore indicators.
2. Use of gear teeth vernier calipers and checking the chordal addendum and chordal height of spur gear.
3. Alignment test on the lathe and milling machine
4. Study of Tool makers microscope and its application
5. Angle and taper measurements by Bevel protractor, Sine bars, spirit level etc.
6. Thread measurement by Two wire/ Three wire method.
7. Surface roughness measurement by Talysurf instrument.
8. Use of straight edge and sprit level in finding the flatness of surface plate.

Section B:

1. Calibration of Pressure Gauges
2. Calibration of transducer or thermocouple for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Study and calibration of capacitive transducer for angular measurement.
5. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
6. Study and calibration of a rotometer for flow measurement.
7. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
8. Study and calibration of Mcleod gauge for low pressure.

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15A03801 INDUSTRIAL ENGINEERING
(MOOCS-II)

UNIT I

Concepts of Management-Administration and Organization – Functions of Management – Schools of Management Thought: Taylor's Scientific Management, Fayol's Principles of Management, Douglas Mc-Gregor's Theory X and Y, Mayo's Hawthorne Experiments, Hertzberg's Two factor Theory of Motivation, Maslow's Hierarchy of Human needs – Systems Approach to Management.Organizational Structures-Functional- Divisional- Matrix etc., Basic Concepts Related to Organization – Departmentation and Decentralization and their Merits, Demerits and Suitability

UNIT II

Plant Location: Definition, Factors affecting the Plant Location, Comparison of Rural and Urban sites, Selection of Plant Location – Types of Production; Plant Layout: Definition, Objectives, Types of Plant Layout - Materials Handling: Functions-Objectives – Types, Selection Criteria of Material Handling Equipment.

UNIT III

Work Study – Definition, Objectives, Method Study – Steps Involved – Various Types of Process Charts –Micro motion and Memo motion Studies. Work Measurement - Definition, Time Study, Steps involved - Equipment, Different Methods of Performance Rating - Allowances, Standard Time Calculation. Work Sampling - Definition, Steps Involved, Standard Time Calculations - Applications.

UNIT IV

Inventory Models- Deterministic models- EOQ Models – With and Without Shortages Models; Inventory Models with Price Breaks -Probabilistic Models –Discrete Variable, Continuous Variable. Inventory Control Systems

UNIT V

Inspection & Quality Control: Statistical Quality Control- Techniques-Variables and Attributes- Control Charts: X and R Charts; P Charts and C Charts. Acceptance Sampling Plan - Single Sampling and Double Sampling Plans- OC Curves. Introduction to TQM- Quality circles-BIS & ISO Standards-Importance .

Text Books:

1. Manufacturing Organization and Management, T.Amrine/ Pearson, 2nd Edition, 2004
2. Industrial Engineering and Management ,O.P.Khanna, DhanpatiRai, 18th edition, 2013.
3. Industrial Engineering and Management, Dr. C.Nadamuni Reddy, New Age International Publishers, 1st edition, 2011.

Reference Books:

1. *Industrial Engineering and production management, MartindTelsang S.Chand..*
2. *Work Study by ILO(International Labour Organization)*
3. *Management by James AF Stoner, Freeman 6th Ed, Pearson Education, New Delhi,2005*
4. *Production and Operations management, PanneerSelvam, PHI,2004.*
5. *Statistical Quality Control by EL Grantt, McGrawhil*
6. *Motion and time studies by Ralph M Barnes, John Wiley and Sons,2004*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech IV-II Sem. (ME)

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15A03802 PRODUCT DESIGN
(MOOCS-II)

Course Objective:

To make the students understand the product development process, requirements setting, conception design,, embodiment design principles, to understand the basics of mechatronics and adaptronics.

UNIT I

PRODUCT DEVELOPMENT PROCESS

General problem solving process - Flow of Work during the process of designing - Activity Planning Timing and scheduling, Planning Project and Product Costs - Effective Organization Structures - Interdisciplinary Cooperation, Leadership and Team behavior.

UNIT II

TASK CLARIFICATION

Importance of Task Clarification - Setting up a requirements list - Contents, Format, Identifying the requirements, refining and Extending the requirements, Compiling the requirements list, Examples. Using requirements lists - Updating, Partial requirements lists, Further uses - Practical applications of requirements lists.

UNIT III

CONCEPTUAL DESIGN

Steps in Conceptual Design.

Abstracting to identify the essential problems - Aim of Abstraction, Broadening the problem. Formulation, Identifying the essential problems from the requirements list, Establishing functions structures, Overall function, Breaking a function down into sub-functions.

Developing working structures - Searching for working principles, Combining Working Principles, Selecting Working Structures, Practical Application of working structures.

Developing Concepts - Firming up into principle solution variants, Evaluating principle solution variants, Practical Applications of working structures.

Examples of Conceptual Design - One Handed Household Water Mixing Tap, Impulse - Loading Test Rig.

UNIT IV

EMBODIMENT DESIGN - Steps of Embodiment Design, Checklist for Embodiment Design Basic rules of Embodiment Design Principles of Embodiment Design - Principles of Force Transformations, Principles of Division of Tasks, Principles of Self-Help, Principles of Stability and Bi-Stability, Principles of Fault-Free Design

Guide for Embodiment Design - General Considerations, Design to allow for expansion, Design to allow for creep and relaxation, Design against Corrosion, Design to minimize wear, Design to Ergonomics, Design for Aesthetics, Design for Production, Design for Assembly, Design for Maintenance, Design for Recycling, Design for Minimum risk, Design to standards.
Evaluation of Embodiment Designs.

UNIT V

MECHANICAL CONNECTIONS, MECHATRONICS AND ADAPTRONICS
Mechanical Connections - General functions and General Behavior, Material connections, From Connections, Force connections, Applications.
Mechatronics - General Architecture and Terminology, Goals and Limitations, Development of Mechatronic Solution, Examples.
Adaptronics - Fundamentals and Terminology, Goals and Limitations, Development of Adaptronics Solutions, Examples.

Text Books:

1. Engineering Design: G.Paul; W. Beitzetal, Springer International Education 2010.
2. Product Design And Developement: Kevin Otto: K. Wood Pearson Education 2016.

Reference Books:

1. Product Planning Essentials: Kenith B. Kahu, Yes dee Publishing 2011.
2. Product Design and Development: K.T. Ulrich TMH Publishers 2011.

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15A03803 COMPOSITE MATERIALS (MOOCS-II)

Unit-I

Introduction to Composite Materials: Introduction, Classification: Polymer Matrix Composites. Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber. Reinforced Composites and nature-made composites, and applications

Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and boron carbide. fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosets, Metal matrix and ceramic composites.

Unit-II

Manufacturing methods: Autoclave curing, tape production, moulding methods, filament winding, hand layup, pultrusion, RTM. Compression moulding, tape winding.

Macromechanical Analysis of a Lamina: Introduction ,Definitions: Stress, Strain ,Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

Unit-III

Micromechanical Analysis of a Lamina: Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi Empirical Models ,Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion

UNIT-IV

Macromechanical Analysis of Laminates: Introduction, Laminate Code, Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate , Hygrothermal Effects in a Laminate, Warpage of Laminates

UNIT-V

Failure Analysis and Design of Laminates: Introduction, Special Cases of Laminates, Failure Criterion for a Laminate.

Text Books:

1. Engineering Mechanics of Composite Materials- Isaac and M Daniel, Oxford University Press, 1994.
2. Mechanics of Composite Materials, R. M. Jones, Mc Graw Hill Company, New York, 1975.

References:

1. Analysis and performance of fibre Composites, B. D. Agarwal and L. J. Broutman Wiley- Interscience, New York, 1980.
2. Mechanics of Composite Materials, Second Edition (Mechanical Engineering)- Autar K. Kaw, Publisher: CRC
3. Finite Element Analysis of Composite Materials, Ever J. Barbero , CRC Press, 2007.
4. Analysis of Laminated Composite Structures, L. R. Calcote, Van Nostrand Rainfold, New York, 1969.
5. Mechanics of Composite Materials and Structures, Madhujit Mukhopadhyay, University Press, 2009.
6. Composite Materials Science and Engineering, Krishan K. Chawla, Springer, 2009

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15A03804 POWER PLANT ENGINEERING
(MOOCS-III)

UNIT I

Introduction To The Sources Of Energy – Resources and Development of Power in India. Layouts of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles - Comparison and Selection,

Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor – Tariff - Related Exercises. Effluents from Power Plants and Impact on Environment – Pollutants and Pollution Standards – Methods of Pollution Control. Inspection And Safety Regulations.

UNIT II

Steam Power Plant : Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant : Combustion Process : Properties of Coal – Overfeed and Under Feed Fuel Beds, Traveling Grate Stokers, Spreader Stokers, Retort Stokers, Pulverized Fuel Burning System And Its Components, Combustion Needs and Draught System, Cyclone Furnace, Design and Construction, Dust Collectors, Cooling Towers And Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.CO2 Recorders

UNIT III

Diesel Power Plant: Diesel Power Plant: Introduction – IC Engines, Types, Construction– Plant Layout with Auxiliaries – Fuel Storage Gas Turbine Plant : Introduction – Classification - Construction – Layout With Auxiliaries – Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

UNIT IV

Hydro Electric Power Plant: Water Power – Hydrological Cycle / Flow Measurement – Drainage Area Characteristics – Hydrographs – Storage and Pondage – Classification of Dams and Spill Ways.

Hydro Projects and Plant: Classification – Typical Layouts – Plant Auxiliaries – Plant Operation Pumped Storage Plants. .

UNIT V

Power from Non-Conventional Sources: Utilization of Solar Collectors- Principle Of its Working, Wind Energy – Types of Turbines – HAWT & VAWT-Tidal Energy. MHD power Generation.

Nuclear Power Station: Nuclear Fuel – Nuclear Fission, Chain Reaction, Breeding and Fertile Materials – Nuclear Reactor –Reactor Operation.

Types of Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast

breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding –

Radioactive Waste Disposal.

Text Books:

1. Power plant Engineering, P.K. Nag, TMH, 3rd edition, 2013.

2. A course in power plant Engineering, Arora and S. Domkundwar.

Reference Books:

1. A Text Book of Power Plant Engineering , Rajput , Laxmi Publications, 4th edition, 2012.

2. Power plant Engineering, Ramalingam, Scietech Publishers

3. power plant engineering P.C. Sharma, S.K. Kataria Publications,2012.

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15A03805 GAS TURBINES AND JET PROPULSION
(MOOCS- III)

UNIT-I

Gas Turbine Operating Cycles: Simple open cycle gas turbine or air standard Brayton cycle, Actual Brayton cycle, the cycle air flow rate, the cycle work ratio, optimum pressure ratio or maximum cycle thermal efficiency, means of improving the efficiency and the specific out put of simple cycle.

UNIT-II

Gas Turbines; gas turbine applications, gas turbine advantages & disadvantages, energy flow & back work, deviation from ideal cycle, gas turbine with regeneration, thermal efficiency of gas turbine with & without regenerator, gas turbine engines, inter-cooling & reheating, turbojet engine, turbofan engine, turboprop engine.

UNIT-III

Jet propulsion: Historical sketch- reaction principle- essential features of propulsion devices- Thermal jet engines, classification of – energy flow, thrust, thrust power and propulsion efficiency- need for thermal jet engines and applications.

Turboprop and turbojet – thermodynamic cycles, plant layout, essential components, and principles of operation – performance evaluation – thrust augmentation and Thrust reversal – contrasting with piston engine propeller plant.

UNIT-IV

Ram jet- Thermo dynamic cycle, plant lay out, essential components – principle of operation – performance evaluation – comparison among atmospheric thermal jet engines- serqujet and pulse jet, elementary treatment.

Rocket Engines: Need for, applications- basic principle of operation and parameters of performance – classification, solid and liquid propellant rocket engines, advantages, domains of application – propellants – comparison of propulsion systems.

UNIT-V

Rocket Technology: Flight mechanics, application thrust profiles, acceleration-staging of rockets, need for – feed systems, injectors and expansion nozzles – rocket transfer and ablative cooling.

Testing & instrumentation - need for Cryogenics – advanced propulsion systems, elementary treatment of Electrical nuclear and plasma Arc Propulsion.

TEXT BOOKS:

1. Gas Turbines , V. Ganesan TMGH
2. Gas turbines , cohen , Rogers & Sarvana Muttoo , Addision Wiley & longman

REFERENCES BOOK:

1. Thermodynamics of propulsion, Hill & Paterson.
2. Rocket Propulsion , Sutton.
3. Element of Gas Turbines propulsion , Jack D Matingly, MGH

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15A03806 ENERGY MANAGEMENT
(MOOCS-III)

UNIT - I

ENGINEERING ECONOMICS:

Managerial objectives - steps in planning- Capital budgeting- Classification of costs- Interest- Types- Nominal and effective interest rates Discrete and continuous compounding - discounting - Time value of money - Cash flow diagrams - Present worth factor, Capital recovery factor, Equal annual payments - Equivalence between cash flows.

UNIT - II

DEPRECIATION & COST ANALYSIS:

Aims-Physical depreciation-Functional depreciation- Methods of depreciation-Straight line method, Declining balance method, Sum of years digits method, Sinking fund method, Service output method- Capital recovery with return-Service life estimation-Morality curves. Break even analysis and break even chart- Minimum cost analysis-Benefit cost analysis- Life cycle cost analysis.

UNIT - III

PROJECT MANAGEMENT:

Methods of investment appraisal- Rate of return method, Payback period method, Net present value method (NPV)- Internal Rate of Return method(IRR)- Adoption of the methods in energy conservation campaign- Types of projects- Purpose of project management - Classification – Role and qualities of project manager - Types of budgets - Budget committee – budgeting.

ENERGY MANAGEMENT PROGRAMS:

Necessary steps of energy management programmer - Concepts of Energy management - General principles of energy management – Energy management in manufacturing and process industries- Qualities and functions of Energy manager - Language of Energy manager-Checklist for top management.

UNIT - IV

ENERGY AUDITING:

A definition- Objectives- Level of responsibility- Control of Energy- Uses of Energy checklists - Energy conservation- Energy index - Cost index - Pie charts-sankey diagrams Load profiles - Types of energy audits- Questionnaire - Energy audit of industries - General energy audit- Detailed energy audit - Energy saving potential.

UNIT - V

ENERGY POLICY, SUPPLY, TRADE& PRICES:

Energy resources in India – level of power generation – transmission & distribution of power. Indian energy policy,Energy trade & its economic impacts – domestic energy production – Energy transformation & distribution & energy self sufficiency. International & National crude oil prices – domestic fuel prices – natural gas, LPG, kerosene and firewood - pricing policy.

TEXT BOOKS:

1. Energy Management, Murphy W.R and Mckay G, , Elsevier, 2007
2. Albert Thumann, Handbook of Energy Audits, The Fairmont Press Inc., Atlanta gergia, 1979.

REFERENCES BOOKS:

1. Albert Thumann, Plant Engineer and Management guide to Energy Conservation, Van Nost and Reinhold Co., Newyork.
2. Energy Audits, E.E.O.-Book-lets, U.K. 1988.
3. Craig B.Smith, “Energy Management Principles”, Pergamon Press.
4. The role of Energy Manager, E.E.O., U.K.
5. The Energy conservation Design Resource Hand Book-The Royal architectural Institute of Canada.
6. Energy Management Hand Book-Ed. By Wayne C. Turner, John Wiley and sons, 1982.