JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

Course Structure for Mechanical Engineering
B. Tech Course
(2013-14)

IV B. Tech – I Sem

S.No.	Course Code	Subject	Theory	Tu	Lab	Credits
1	13A03701	Operations Research	3	1	-	3
2	13A03702	Automation and Robotics	3	1	-	3
3	13A03703	Finite Element Methods	3	1	-	3
4	13A03704	Metrology and Measurements	3	1	-	3
5	13A03705 13A03706 13A03707	CBCC II a. Automobile Engineering. b. Tool Design c. Tribology	3	1	-	3
6	13A03708 13A03709 13A03710	CBCC III a. Computational Fluid Dynamics b. Concurrent Engineering c. Production & Operations Management	3	1	-	3
7	13A03711	Metrology and Measurements Laboratory	-	-	4	2
8	13A03712	Computer Aided Engineering Laboratory	-	-	4	2
		Total	**18**	**06**	**08**	**22**

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B.Tech. IV-I Sem. (M.E)	**Th**	**Tu**	**C**
	3	**1**	**3**

(13A03701) 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; Optimality Methods-Stepping Stone Method and Modified Distribution (MODI) Method; 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 – 2 X 2 Games – Dominance Principle– Solution by Graphical Method of m X 2 & 2 X n games

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.

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 and Maintenance Analysis: Introduction – Types of Maintenance, 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=ug7O1lSZyg0
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. *Introduction to Operations Research, H.A.Taha, PHI, 9th edition, 2013.*
2. *Operation Research, J.K.Sharma,Trinity Press, 6th edition.*

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, Pradeeo J Jha, Mc Graw Hill,2015*
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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	3	**1**	**3**

(13A03702) AUTOMATION AND ROBOTICS

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, Quantitative analysis of flow lines.
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 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:
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.
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 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
Robot Programming: Methods of programming - requirements and features of programming languages, software packages. Problems with programming languages.
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:
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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	3	**1**	**3**

(13A03703) 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. *Introduction to FEM, J. N. Reddy, TMH Publishers, New Delhi.*
2. *Finite Element Analysis, C.S. Krishna Moorthy, TMH Publishers, New Delhi.*
3. *Fundamentals of Finite Element Analysis, David V. Hutton , TMH Publishers, New Delhi.*
4. *Finite Element Analysis, G.Lakshmi Narasaiah, BS Publication.*
5. *A Primer on Finet Element Analysis, Anand V.Kulkarni, Venkatesh K. Havanur, University Science Press, 2014*
6. *Finite Element Analysis- Proceedures in Engineering, H.V.Lakshminarayana, Universities Press,2013.*

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*

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B.Tech. IV-I Sem (M.E)	**Th**	**Tu**	**C**
	3	**1**	**3**

(13A03704) 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 Dotson ,4e, Thomson*
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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	3	**1**	**3**

(13A03705) AUTOMOBILE ENGINEERING
(CBCC II)

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

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 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

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 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

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:

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

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:

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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(13A03706) 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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(13A03707) TRIBOLOGY
(CBCC II)

Course Objective:
Students should be able to understand the effect and importance of friction between different surfaces and should know to calculate the friction.
Students must be able to know the phenomenon of wear between surfaces in contact and its implications.
Students should be able to understand the principles, methods, purpose and selection of lubricants for the reduction of friction.
Students should be able to understand the lubrication theory and the flow of lubricants with different applications.
Students should know the surface treatment methods to improve the wear resistance and friction properties. Material selection for different types of bearings could be understand

UNIT I

SURFACES AND FRICTION: Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction - Adhesion Ploughint- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction - Stick slip motion - Measurement of Friction.

Learning Outcome & Suggested Student Activities:
Students can understand the characteristics of engineering surfaces, sources of friction, friction characteristics of metals and non metals and friction measurements. The following URLs are highly useful for better understanding. For the topic rolling friction go through the website http://www.phy.davidson.edu/fachome/dmb/PY430/Friction/rolling.html. For friction related topics go through the link http://nptel.iitm.ac.in/courses/112102015/5 and http://nptel.iitm.ac.in/courses/112102014/3

UNIT II

WEAR: Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear - Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture wear - Wear of Ceramics and Polymers - Wear Measurements.

Learning Outcome & Suggested Student Activities:
Students can understand the wear and wear mechanisms, situations causing wear and methods to reduce and also know the materials for a particular wear situation. Students are advised to visit materials lab in the college for understand the properties and also visit following URLs http://www.substech.com/dokuwiki/doku.php?id=mechanisms_of_wear http://www.substech.com/dokuwiki/doku.php?id=tribology_of_ceramics&s=film%20lubrication%20theory http://nptel.iitm.ac.in/courses/112102015/11 and http://nptel.iitm.ac.in/courses/112102014/6

UNIT III

LUBRICANTS AND LUBRICATION TYPES: Types, properties, Requirements of Lubricants - Testing methods - Hydrodynamic Lubrication - Elasto hydrodynamic lubrication- Boundary Lubrication, Mist lubrication, Requirements of lubrication, Solid Lubrication, Hydrostatic Lubrication.

Learning Outcome & Suggested Student Activities:
Students can understand the properties of different lubricants used for various applications, testing

methods of lubrications and types of lubrications.Students are able to identify the lubrication modes such as hydrodynamic lubrication, elasto-hydrodynamic lubrication, formulate elasto-hydrodynamic lubrication models for line and point contacts. Students are advised to visit automobile workshop/various labs in the college and to know how the lubricants are using for different applications. The following URLs are useful for better understanding
http://www.substech.com/dokuwiki/doku.php?id=classification_of_lubricants&s=types%20properties%20lubricants
http://nptel.iitm.ac.in/courses/112102015/17 and http://nptel.iitm.ac.in/courses/112102014/11

UNIT IV

FILM LUBRICATION THEORY: Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings - Virtual Co-efficient of friction - The Somerfield diagram.

Learning Outcome &Suggested Student Activities:
Students can able to understand the theory of film lubrication, principles of bearing selection, reaction torque on the bearings, virtual co-efficient of friction, somerfield diagram and bearing arrangement in machines. The students are advised to observe the working of journal bearing in any workshops/ machine labs an also visit following URLs http://nptel.iitm.ac.in/courses/112102015/24 and http://nptel.iitm.ac.in/courses/112102014/19
http://rotorlab.tamu.edu/me626/Notes_pdf/Modern%20Lub%20Notes%2001-15.pdf.

UNIT V

SURFACE ENGINEERING AND MATERIALS FOR BEARINGS: Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing - Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

Learning Outcome &Suggested Student Activities:
Students can understand how the surface treatment methods are useful to improve the wear resistance and friction properties for the mating surfaces and also know the selection of bearing materials for different types of bearings. Students are advised to visit bearings manufacturing industry to understand design concepts, materials and also visit following URLs
http://www.substech.com/dokuwiki/doku.php?id=engine_bearing_materials&s=materials%20bearings
http://nptel.iitm.ac.in/courses/112102015/28 and http://nptel.iitm.ac.in/courses/112102014/27.

Text Books:

1. I.M. Hutchings, Tribology, " Friction and Wear of Engineering Material ", Edward Arnold, London, 1992.

Reference Books:

1. T.A. Stolarski, " Tribology in Machine Design ", Industrial Press Inc., 1990.
2. Kenneth C Ludema, Friction, Wear, Lubrication: A textbook in Tribology, CRC Press,1996.
3. A.Cameron, " Basic Lubrication theory ", Longman, U.K.., 1981.
4. M.J.Neale (Editor), " Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K., 1975.
5. B.C. Majumdar "Introduction to Tribology bearings", S. Chand

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(13A03708) 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 Mechannics 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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(13A03709) CONCURRENT ENGINEERING
(CBCC III)

Course Objective:
Student has to understand the concept and need for sequential engineering or Concurrent engineering and it's benefit for the modern industry.
Student has to understand the co-operation/ coordination required between the different departments like marketing, design and the latest softwares available sofar
The student has to know the different procedures to be followed during the design, modifications, and optimization techniques for the Design for Manufacture (DFM).
The student has to understand the importance of quality of the product and know the methods of evaluating the quality.
The student must be able to assess the reliability & economics of the Design for Manufacture (DFM) being done/ learned.

UNIT I

INTRODUCTION: Sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs.

SUPPORT FOR CE: Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process.

Learning Outcome & Suggested Student Activities:
Students can understand the meaning, objectives and benefits of the concurrent engineering, life-cycle design of the products, structure and organisation and implementation process of the CE.
Students are advised to refer text book mikell P. Groover for CE definition & advantages and for solid modeling, Besterfield on quality control for it supports and also visit URLs www.perfectlogic.com/articles/AI/ExpertSystems/ExpertSystems.html.

UNIT II

DESIGN PRODUCT FOR CUSTOMER: Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD). Modeling of Concurrent engineering design- Compatibility approach, Compatibility index, implementation of the Compatibility model, integrating the compatibility Concerns

Learning Outcome & Suggested Student Activities:
Student can understand the design of the product as per the customer requirements and also understand the co-operation/ coordination required between the different departments like marketing, design and the latest softwares available so far.
Students are advised to visit industries like IFB, ITW for better understanding of the concept.

UNIT III

DESIGN FOR MANUFACTURE (DFM): Introduction, role of DFM in CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assembliability.

Learning Outcome & Suggested Student Activities:
Students can understand the role of design for manufacturing in concurrent engineering, different

DFM methods, creative design methods and computer based approach to DFM.
Student can be explained the procedures being followed by companies such as KPIT Cummins-Pune and made to visit the same which is nearby.

UNIT IV

QUALITY BY DESIGN: Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach.

Learning Outcome & Suggested Student Activities:
Students can understand the importance of quality during the product design and methods used to evaluate the quality.
Student can be given a small component for Design for Manufacture (DFM) in consultation with industries

UNIT V

DESIGN FOR X-ABILITY: Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.

Learning Outcome & Suggested Student Activities:
Students can understand the design of the product for reliability, maintainability and economics. Students are advised to visit the following URLs www.lumbs.lu.se/database/alumini/03-04/theses/jeganova-julija.pdf for lifecycle design of products and also visit www.rug/nl/staff/e.w.berghout/nijlandberghout_flcmgt.pdf for life cycle semi realization.

Text Books:

1. Concurrent Engineering- Kusiak - John Wiley & Sons
2. Concurrent Engineering- Menon - Chapman & Hall

Reference Books:

1.Integrated Product Development/Anderson MM and Hein, L.Berlin, Springer Verlog,1987.
2.Design for Concurrent Engineering/ Cleetus, J. Concurrent Engg. Research Centre,Morgantown,WV, 1992.

Student can be directed to industries who uses the Concurrent Engineering concepts.

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	3	**1**	**3**

(13A03710) 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.

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

Scheduling Policies – Techniques, flow shop and job shop Scheduling techniques.
Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems-(S, s) Policy.

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. Inventory Control Theory and Practice , Martin K. Starr and David W. Miller.
3. Production Control A Quantitative Approach , John E. Biegel.
4. Operations Management , Joseph Monks.
5. Operation Management by Jay Heizar& Read new Pearson

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(13A03711) METROLOGY AND 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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(13A03712) COMPUTER AIDED ENGINEERING LABORATORY

I. Introduction to Analysis Software Package

II. Structural Analysis:(Any Four exercises)

Analysis of a rectangular plate with a hole

1. Analysis of a truss member under loading
2. Analysis of a bracket plate with axial loading
3. Analysis of a bracket plate with eccentric loading
4. Static Analysis of Prismatic bar
5. Static Analysis of a Corner Bracket
6. Static Analysis of beam
7. Analysis of Thermally Loaded support Structure
8. Analysis of Hinged support member
9. 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. CAM (Any Six exercises)

1. Introduction to CNC & NC Machines
2. Introduction to CNC & NC part programming – for Different operations like Turning, Threading, Milling, Drilling etc., (G-Codes & M-Codes)
3. Experiments on CNC lathe -Turning, Threading operations
4. Experiments on Milling Machine - Plane Milling, Drilling Operations
5. Experiment on Robot – pick up an object with & without using teach window
6. Developing a CNC code for a given job using
   i) Solid works- CAM
   ii) PRO-E- CAM
   iii) MASTER CAM
   iv) Edge CAM