

**AU- 6001 Heat and Mass Transfer**

**Unit-1 Basic Concepts:** Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzman law; thermal resistance and conductance, analogy between flow of heat and electricity, combined heat transfer process; **Conduction:** Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates, thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical-insulation-thickness for pipes, effect of variable thermal conductivity. Heat source system

**Unit 2 Extended surfaces (fins):** Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness, applications; **Unsteady heat conduction:** Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.

**Unit 3 Convection:** Introduction, free and forced convection; principle of dimensional analysis, Buckingham 'pie' theorem, application of dimensional analysis of free and forced convection, empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.

**Unit 4 Heat exchangers:** Types- parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, log-mean temperature difference (LMTD), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method; **Mass transfer:** Fick's law, equi-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapour in a stationary medium.

**Unit 5 Thermal radiation:** Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, analogical electrical network, radiation shields. **Boiling and condensation:** Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and its modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.

**References:**

1. Sukhatme SP; Heat and mass transfer; University Press Hyderabad
2. Holman JP; Heat transfer; TMH
3. Nag PK; heat and Mass Transfer; TMH
4. Dutta BK; Heat Transfer Principles And App; PHI Learning
5. Mills AF and Ganesan V; Heat transfer; Pearson
6. Cengel Yunus A; Heat and Mass transfer;TMH
7. Yadav R; Heat and Mass Transfer; Central India pub-Allahabad
8. Baehr HD;Stephan K; Heat and Mass Transfer; MacMillan Pub
9. Incropera FP and Dewitt DP; Heat and Mass transfer; Wiley

# **RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL**

## **Credit Based Grading System**

### **Automobile Engg, VI-Semester**

#### **AU- 6002 Automotive Design and Drawing**

##### **Unit-1**

Cam design: Introduction, cam terminology, types of cam ,follower and follower motions. Motion constraints, single-dwell and double-dwell cam design. Critical path motion, pressure angle and radius of curvature of cam motion; introduction of SOHC and DOHC.

##### **Unit-2**

Brake design: Definition, classification and requirement of brake, energy absorption and heat dissipation through brake, design of shoe brake and double shoe brake, internal expanding brakes, band and block brake and disc brake.

##### **Unit-3**

Design of suspension spring and front axle: Types of suspension system, types of suspension springs, design of leaf spring, coil spring; design of front axle beam.

##### **Unit-4**

Design of I C engine parts: introduction to principle parts of an I.C engine, design of cylinder and cylinder liner, piston, connecting rod, crank shaft (calculation for bearing pressure and stresses in crank shaft); design of valves; vehicle design and data characteristics.

**Unit-5** Assembly drawings: engines, chassis and other automobile systems.

- a) Piston Assembly
- b) Connecting Rod Assembly
- c) Shackle Assembly
- d) Wheel Cylinder Assembly
- e) Master Assembly

##### **References:**

1. Bhat, ND; Machine Drawing; Charotar
2. Machine Drawing by K R Gopal Krishna, Subhash Publication, Bangalore
3. Automotive Engineering by Drawing by R B Gupta
4. Singh A; Machine Drawing; TMH
5. Narayana and Reddy; Machine Drawing; New age, Delhi.
6. Agarwal and agrawal; Engineering Drawing; TMH
7. Shigley JE et al; Mechanical Engineering Design, TMH
8. Kulkarni SG; Machine Design; TMH
9. Mubeen and Mubeen; Machine Design.
10. Luzzader WJ, Duff JM; Fundamental of Engg Drawing and Interactive Graphics; PHI.

##### **List of Experiments (Pl. expand it):**

Design & Drawing of the above mentioned components & assemblies

**AU- 6003 Automotive Electricals and Electronics**

**Unit 1** Automotive batteries: Starter batteries- principle, construction & operation of lead-acid battery; battery capacity, efficiency & rating; tests on batteries; charging methods; battery faults; battery maintenance; maintenance-free batteries; Traction batteries: Applications; electric traction; electric drive vehicle layout.

**Unit 2** Starter and charging systems: Requirements; principle, construction & working of starter motor; starting motor drive mechanisms; starter switch; starting system faults; Generating system: Working principle of dc generator & ac alternator; armature reaction; cut-out relay; voltage & current regulator systems.

**Unit 3** Lighting and auxiliary systems: Development of lighting technology; principle of automobile illumination; head lights; tail lights; traffic lights; Auxiliary systems: Speedometer; electric horn; wind screen wipers; alarm systems; central locking system; immobilizer system; power windows; different types of gauges.

**Unit- 4** Electronic engine control and sensors: Need of electronic engine control; engine functions & control; electronic fuel control system; basic sensor arrangement; sensors & actuators; types of sensors-oxygen sensor, vehicle speed sensor, detonation sensor, maf sensor, map sensor, rpm sensor, throttle position sensor, temperature sensor.

**Unit-5** Electronic fuel injection and ignition systems: Introduction; fuel back carburetor system; throttle body injection; multi point fuel injection; Robert Bosch gasoline fuel injection system; ford electronic gasoline fuel injection system; injection system controls; Ignition systems: Introduction; advantages of electronic ignition systems; principle, operation & types of solid state ignition system, electronic spark timing control.

**References:**

- 1) Norm Chapman Delmar; Principles of Electricity And Electronics for Automotive; Cengage
- 2) BOSCH-SAE; Automotive Electrics & Electronics-
- 3) William B Ribbens- Newnes; Understanding Automotive Electronics-
- 4) Tom Denton; Automobile Electrical And Electronic Systems; SAE
- 5) Kanemitsu Nishio; The Fundamentals of Automotive Engine Control Sensors; Fontis Media

**List of Experiments (Pl. expand it):**

1. Study of lead acid and maintenance free batteries,
2. Study of starter and Bendix drive
3. Study of electric generation and charging systems
4. Study of lighting systems;
5. Study of electronic fuel injection systems
6. Study of various sensors and detectors
7. Study of vehicles control systems

# **RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL**

## **Credit Based Grading System**

### **Automobile Engg, VI-Semester**

#### **AU- 6004 Two and Three wheelers**

##### **Unit 1**

Power Unit: Two stroke and four stroke SI engine, merits and demerits for two & three wheelers. Symmetrical and unsymmetrical port timing diagrams. Types of scavenging processes merits and demerits, scavenging efficiency. Scavenging pumps.

##### **Unit 2**

Rotary valve engine. Fuel system. Lubrication system. Magneto coil and battery coil spark ignition system. electronic Ignition system. Starting system. Kick starter system. Chassis and Sub-Systems: Mainframe, its types. Chassis and shaft drive. Single, multiple plates and centrifugal clutches. Gear box and gear controls.

##### **Unit 3**

Front and rear suspension- systems. Shock absorbers. Panel meters and controls on handle bar. Brake and Wheels: Drum brakes, Disc brakes, front and rear brake links layouts. Spoked wheel, Cast wheel. Disc wheel. Disc types. Tyres & tubes.

**Unit 4** Two Wheelers: Case study of major Indian models of motorcycles, SCOOTERS AND MOPEDS. Bajaj, Vespa, Lambretta scooters. Enfield, TVS-Suzuki, Hero-Honda, Yamaha RX-100, Kawasaki Bajaj Motor cycle. Kinetic Spark, Hero Majestic, TVS mopeds. Servicing and maintenance.

**Unit 5** Three Wheelers: Case study of Indian Models. Front engine and rear engine. Auto rickshaws. Pickup van. Delivery Van and Trailer.

##### **References:**

1. Irving. P.E., Motor cycle Engineering, Temple Press Book, London, 1992
2. The Cycle Motor Manual, Temple Press Ltd., London, 1990.
3. Encyclopedia of Motorcycling, 20 volumes, Marshall Cavendish, New York and London, 1989.
4. Bryant. R.V., Vespa Maintenance and Repair series.
5. Raymond Broad, Lambretta – A practical guide to maintenance and repair, 1987

##### **List of Experiments (Pl. expand it):**

1. Comparative analysis of various brands of two wheeler in Indian Market.
2. Comparative study of Gear mechanism in Scooter.
3. Comparative study of Gear mechanism in Motorcycle.
4. Study of any three wheeler of Indian Market.
5. Study of any three wheeler pickup Van of Indian Market.

# **RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL**

## **Credit Based Grading System**

### **Automobile Engg, VI-Semester**

#### **Elective –II AU- 6005 (1) Operations Management**

**Unit 1** Operations Management (OM): Definition, history, industrial and IT revolution (ERP); tangible and service products continuum, employment shift from agriculture, manufacturing to service; customer orientation; basic process formats on product volume-variety graph; concept of raw process time, critical WIP, bottle neck thruput and cycle-time with example of Penny-Fab-1,2; Little's law, best and worst case performance, thruput and cycle time formula in practical-worst-case; criteria of performance, decision area, business strategy, environment scan, SWOT, Porters' five forces, core competency, competitive priorities of cost, quality, time and flexibility, order winners; production strategy of Make To Order-MTO, MTS and ATO (assemble to order); productivity, standard of living and happiness.

**Unit 2** Product:-Life Cycle and PLC management; design steps, evolution and innovation, traditional v/s concurrent design, form and functional design, simplification and standardization, differentiation/ mass customization, modular design, design for mfg and environment (DFM, DFE), technologies used in design. Service characteristics and classification based on people-things v/s direct-indirect service actions, service triangle of customer, provider and system; technical and functional (delivery) service quality and other service performance factors, Valerie's service quality model; globalization of services.

**Unit 3** Processes: transformation and value addition, selection based on cost, quality and flexibility considerations; reliability, bath-tub curve, series and parallel components, MTBF; availability and maintainability, preventive maintenance, TPM; value analysis; replacement models; Quality-definition, Taguchi loss function, cost of quality, chain action of improving quality to productivity to motivation and low cost; product and process specs; the funnel-marble experiment and variance reduction, process capability, six sigma and its implementation by DMAIC, QFD, TQM and ISO-9000.

**Unit 4** Plant-facilities: Impact of organization strategies on choice of region and site, existing or new organization, decision-affecting factors for location, load distance, dimensional and factor analysis methods, Brown-Gibson model, foreign locations, non-profit govt. services (health, school) locations. facility layout objectives and factors, basic layouts, merits and optimization; subjective relationship ranking method, computer programs CRAFT and 3-d modeling; problems of inventories flow and operators in process layout and inflexibility in product layout, flexible cellular layout, group technology; capacity and equipment selection, importance of spare capacity to reduce Q-length and cycle time.

**Unit 5** Programs/ procedures of production control (PPC): corporate and production planning process, aggregate plan, master production schedule and material planning; matching supply to demand fluctuations over time horizon, Forecasting elements, time series, regression, causal and Delphi methods; use of LP in aggregate plan and HMMS model, assembly line balancing,

elemental task, station time and cycle time, balance delays; sequencing, Johnson method for n-job 2/3 m/c, NP hard job-shop sequencing, heuristic dispatch rules; synchronous mfg, TOC, drum-buffer-rope and focus on bottleneck as control point; JIT lean mfg, Kanban and CONWIP shop floor controls, Kaizen.

**References:**

1. Chary SN; Production and Operations Management; TMH
2. Hopp W and Spearman M; Factory Physics; TMH
3. Gitlow Howard et al; Quality Management; TMH
4. Stevenson W J; Operations Management; TMH
5. Khanna RB; Production and Operations Management; PHI
6. Vollman, Berry et al; Manufacturing planning and control for SCM; TMH.
7. Chase Richard B et al; Operations management; SIE-TMH
8. Adam EE and Ebert RJ; Production and Operations Management Concepts...; PHI Learning.

**Elective –II AU- 6005 (2) Total Quality Management & Statistical Quality Control**

**Unit 1** Evolution of total quality management, historical perspective, teamwork, TQM and ISO 9000; information technology and Business Process Re-engineering (BPR); TPM and quality awards; aids and barriers to quality mgt, creating vision and initiating transformation, establishing programs for education and self improvements, measurement of key indicators; quality mgt leader; cross functional teams and coordination, policy setting and review, flowchart of policy mgt and relation with daily mgt.

**Unit 2** Process:- definition, variation and feedback, funnel-marble experiment- rules of adjustment and its effects, quality- definition, goalpost and kaizen view, quality of design, conformance and performance; Taguchi loss function, cost of quality, chain action of improving quality to productivity to motivation and low cost; Deming's theory of mgt, fourteen points and variance reduction; attributes enumerative and variables analytic studies.

**Unit 3** SQC-Control charts: basic discrete and continuous distributions, measures of central tendency, variability and shapes, sampling, size and central value theorem, control chart structure, process plotting and stability, study of out-of-control evidences, defect detection and prevention, use of control charts in evaluating past, present and future trends; attribute control charts, count and classification charts, construction and interpretation of  $p$ ,  $np$ ,  $c$  and  $u$  charts, PDSA cycle(plan, do, study, act), R charts,

**Unit 4** Process diagnostics: Between and Within Group variations, periodic and persistent disturbances, control chart patterns-natural, level-shift, cycle, wild, multi-universe, relationship and other out of control patterns; diagnosing a process, brainstorming; cause-effect, systematic and matrix diagrams; change concepts and waste elimination

**Unit 5** Process improvement: Performance and technical specifications, attribute-process and variable process capability studies; unstable and stable process capability studies and examples; attribute and variable improvement studies; Inspection: acceptance sampling(AS)- lot formation, single, double and multiple/sequential sampling plans, operating characteristic (OC) curve, producer and consumer risk, theoretical invalidation of AS, kp rule for stable and chaotic processes.

**References:**

1. Gitlow HS, Oppenheim et al; Quality Management; TMH
2. Juran J. M., Quality Planning and Analysis
3. Sharma P. D, TQM, Sultanchand
4. Naidu Babu and Rajendran; TQM; New age International pub;
5. Chase Richard B et al; Operations management; SIE-TMH
6. Chary SN; Production and Operations Management; TMH
7. Quality Management by Howard S Gitlow, TMH

**Elective –II AU- 6005 (3) IPR (Intellectual Property Rights)**

**Course Objective**

Acquaint the students with the basic concepts of Intellectual Property Rights; and sensitize the students with the emerging issues in IPR and the rationale for the protection of IPR.

**UNIT I Introduction**

Introduction and Justifications of IPR, Nature of IP, Major forms of IP- *Copyright, Patent, Trade Marks Designs, Geographic indication, layout design of Semi conductors, Plant varieties, Concept & Meaning of Intellectual Property.*

Major international documents relating to the protection of IP - *Berne Convention, Paris Convention, TRIPS.* The World Intellectual Property Organization (WIPO).

**UNIT II Copyright**

Meaning and historical development of copyright , Subject matter , Ownership of copyright, Term of copyright, Rights of owner, Economic Rights, Moral Rights. Assignment and licence of rights, Infringement of copyright, Exceptions of infringement, Remedies, *Civil, Criminal, Administrative*, Registration Procedure.

**UNIT III Patents**

Meaning and historical development, . Criteria for obtaining patents, Non patentable inventions, Procedure for registration, Term of patent, Rights of patentee, Compulsory licence, Revocation, Infringement of patents, Exceptions to infringement, Remedies, Patent office and Appellate Board.

**UNIT IV – Trade Marks, Designs & GI**

**Trade Marks:** Functions of marks, Procedure for registration, Rights of holder, Assignment and licensing of marks, Infringement, Trade Marks Registry and Appellate Board.

**Designs:** Meaning and evolution of design protection, Registration, Term of protection, Rights of holder, unregistered designs.

**Geographical Indication:** Meaning and evolution of GI, Difference between GI and Trade Marks, Registration, Rights, Authorised user.



## **UNIT V Contemporary Issues & Enforcement of IPR**

IPR & sustainable development, The Impact of Internet on IPR. IPR Issues in biotechnology, E-Commerce and IPR issues, Licensing and enforcing IPR, Case studies in IPR

### **Course Outcome:**

1. Students will be able to understand Primary forms of IPR
2. Students will be able to assess and critique some basic theoretical justification for major forms of IP Protection
3. Students will be able to compare and contrast the different forms of IPR in terms of key differences and similarities.
4. Students will be able to understand the registration procedures related to IPR.
5. Students will be exposed to contemporary issues and enforcement policies in IPR.

### **References:**

1. P. Narayanan, Intellectual Property Law, Eastern Law House
2. . Neeraj Pandey and Khushdeep[ Dharni, Intellectual Property Rights, PHI, 2014
3. N.S Gopalakrishnan and T.G. Agitha, Principles of Intellectual Property, Eastern Book Co. Lucknow, 2009.
4. Anand Padmanabhan, Enforcement of Intellectual Property, Lexis Nexis Butterworths, Nagpur, 2012.
5. Managing Intellectual Property The Strategic Imperative, Vinod V. Sople, PHI.
6. Prabuddha Ganguli, " Intellectual Property Rights" McGraw Hill Education, 2016.

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**Automobile Engg, VI-Semester**

**AU- 6006 HMT Lab**

**List of Experiments (Pl. expand it):**

- 1 Conduction through a rod to determine thermal conductivity of material
- 2 Forced and free convection over circular cylinder
- 3 Free convection from extended surfaces
- 4 Parallel flow and counter flow heat exchanger effectiveness and heat transfer rate
- 5 Calibration of thermocouple
- 6 Experimental determination of Stefan-Boltzmann constant

# **RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**

Credit Based Grading System

## **Automobile Engineering, VI-Semester**

### **AU-6007 Creativity and Entrepreneurship Development**

#### **Course Objective:**

- Understand and use tools for generating entrepreneurial ideas and problem solving.
- Understand and use tools for the selection of ideas.
- Understand and gain the skills that are needed to implement ideas in today's society
- Understand Entrepreneurship's part in process that includes idea generation and implementation.
- Understand the concept of Entrepreneurship and its place in today's society

#### **Course Outcomes:**

- Recognize an opportunity for a user group and frame an appropriate design challenge that addresses the need for the user.
- Practice observation, interview and empathy skills to evolve a thorough understanding of the needs of the user.
- Share and integrate team leanings.
- Generate, develop and describe creative ideas that address the design challenge.

#### **Syllabus:**

1. The concept of Entrepreneurship, its history and its place in society.
2. The concept of Entrepreneurship and its relation to concept of innovation.
3. Creative processes for idea generation and problem solving.
4. Business plan.
5. Role of creativity, innovation and business research.
6. Entrepreneurship opportunities in contemporary business environment.

#### **Reference Books :**

1. Dollinger M.J. "Entrepreneurship strategies and resources," 3<sup>rd</sup> edition Pearson Education New Delhi.
2. Panda, Shiba charan "Entrepreneurship development", Anmol publication New Delhi.
3. Richard Blundel & Nigel locket, "Exploring Entrepreneurship : practices & perspectives Oxford.
4. Charles E. Banford & Garry D. Bruton, "Entrepreneurship – A small business Approach, Mcgrawhill Education.
5. P. Narayana Reddy, "Entrepreneurship" : Text and cases, Cengage learning
6. Rajeev Roy, "Entrepreneurship" Oxford.