Scheme & Syllabus of UG

Engineering Program

Bachelor of Technology

(B.Tech.)

Electronics & Communication Engineering

2022-23

IPS ACADEMY

INSTITUTE OF ENGINEERING & SCIENCE, INDORE

(A UGC Autonomous Institute affiliated to RGPV)

IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Scheme Based on AICTE Flexible Curriculum

Department of Electronics & Communication Engineering

Bachelor of Technology (B.Tech.) IV Semester

S.No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem	Mid Sem Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	HSMC-EC401	HSMC	Professional Communication Skills	70	20	10	-	-	100	3	-	-	3
2.	PCC-EC401	PCC	OOPS (C++)	70	20	10	60	40	200	3	-	2	4
3.	PCC-EC402	PCC	Analog Communication	70	20	10	60	40	200	3	-	2	4
4.	PCC-EC403	PCC	Linear Integrated Circuit	70	20	10	60	40	200	2	1	2	4
5.	PCC-EC404	PCC	Control System	70	20	10	-	-	100	2	1	-	3
6.	PCC-EC405	PCC	Simulation Lab(MATLAB)	-	-	-	60	40	100	-	-	2	1
7.	PCC-EC406	PCC	Electronics Workshop-II (Sensors and Automation)	-	-	-	60	40	100	-	-	4	2
8.	MC 4	MC	Economic Policies in India	-	-	-	-	-	-	1	-	-	-
			Total	350	100	50	300	200	1000	14	2	12	21

1 Hr Lecture	1 Hr Tutorial	2 Hr Practical
1 Credit	1 Credit	1 Credit

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Department of Electronics & Communication Engineering

PCC-EC401	OOPS(C++)	3L: 0T: 2P (05 hrs)	Credits:04

Recommended Prerequisite: C Language

Course Objective: The objective of the subject is to explore the principles of Object Oriented Programming (OOP) & understand object-oriented concepts & programming.

Module 1 **(08 hrs)**

Introduction: Object oriented programming, Introduction, Application, characteristics, difference between object oriented and procedure programming, Comparison of C and C++, Cout, Cin, Data Type, Type Conversion, Control Statement, Loops, Arrays and string arrays fundamentals, Function, Returning values from functions, Reference arguments, Overloaded function, Inline function, Default arguments, Returning by reference.

Module 2 **(08 hrs)**

Object and Classes: Implementation of class and object in C++, access modifiers, object as data type, constructor, destructor, Object as function arguments, default copy constructor, parameterized constructor, returning object from function, Structures and classes, Classes objects and memory, static class data, Arrays of object, Arrays as class Member Data, The standard C++ String class, Run time and Compile time polymorphism.

Module 3 **(09 hrs)**

Operator overloading and Inheritance: Overloading unary operators, Overloading binary operators, data conversion, pitfalls of operators overloading, Concept of inheritance, Derived class and base class, access modifiers, types of inheritance, Derived class constructors, member function, public and private inheritance.

Module 4 **(08 hrs)**

Pointer and Virtual Function: Addresses and pointers, the address-of operator & pointer and arrays, Pointer and Function pointer, Memory management: New and Delete, pointers to objects, debugging pointers, Virtual Function, friend function, Static function, friend class, Assignment and copy initialization, this pointer, dynamic type information.

Module 5 **(07 hrs)**

Streams and Files: Streams classes, Stream Errors, Disk File I/O with streams, file pointers, error handling in file I/O with member function, overloading the extraction and insertion operators, memory as a stream object, command line arguments, printer output, Function templates, Class templates Exceptions, Containers, exception handling.

Assessment: Mid-term test, Assignment, Quiz and End semester exam.

List of Experiments:

Write a program

1. To find out the largest number using function.
2. To find the area of circle, rectangle and triangle using function overloading.

3. To implement complex numbers using operator overloading and type conversion.
4. To implement using class and object to print bio-data of the students.
5. Defines a class with constructor and destructor which will count number of object created and destroyed.
6. To implement single and multiple inheritances taking student as the sample base class.
7. To add two private data members using friend function.
8. Using dynamic memory allocation to perform 2x2 matrix addition and subtraction.
9. To create a stack using virtual function.
10. To store five student records in a file.
11. To get IP address of the system.
12. To shut down the system on windows operating system

Assessment: Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

Course Outcomes:
Students earning credits will develop ability to:
1. Understand the advantage of object oriented programming over procedure oriented programming.
2. Help students to understand the key features of Object Oriented Programming and Methodology like objects, methods, instance, message passing, encapsulation, polymorphism, data hiding, abstract data and inheritance.
3. Develop understanding of pointers and memory management.
4. Able to develop understanding of file input/output and templates.
5 Implement algorithms of complex problems.

Test /Reference Books:

1. E. Balaguruswami,"Object Oriented Programming in C++", 7th edition, TMH. 2017.
2. Robert Lafore, "Object Oriented Programming in C++", 4th edition, Pearson, 2001.
3. M.T. Somashekare, D.S. Guru, "Object-Oriented Programming with C++", 2nd edition PHI, 2012.
4. Herbert Shildt, "The Complete Reference C++", 4th edition, TMH, 2017.
5. Yashavant Kanetkar, "Let.Us C++", 3rd edition, BPB Publications, 2019

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Department of Electronics & Communication Engineering

PCC-EC402	Analog Communication	3L: 0T: 2P (05 hrs)	Credits:04

Recommended Prerequisite: Engineering Mathematics

Course Objective: The course is designed to cover the fundamentals, principles, concepts, and techniques of analog communication systems like various modulation techniques, data transmission, communication technologies, time-domain and frequency domain multiplexing technique and noise analysis.

Module 1 **(08 hrs)**

Introduction: Frequency domain representation of signal: Fourier transform and its properties, condition of existence, Fourier transform of impulse, step, signum, cosine, sine, gate pulse, constant, properties of impulse function. Convolution theorem (time & frequency), correlation (auto & cross), energy & power spectral density.

Module 2 **(08 hrs)**

Amplitude Modulation: Overview of Communication system, Communication channels Need for modulation, Baseband and Pass band signals, Amplitude Modulation: Double side band with Carrier (DSB-C), Double side band without Carrier, Single Side Band Modulation, DSB-SC, DSB-C, SSB-SC, Generation of AM, DSB-SC, SSB-SC, VSB-SC & its detection, Vestigial Side Band (VSB), Design of amplitude modulator.

Module 3 **(08 hrs)**

Angle Modulation: Introduction and advantages of angle modulation, Types of angle modulation, narrowband FM, wideband FM, its frequency spectrum, transmission BW, methods of generation (Direct & Indirect), detection of FM (discriminators: balanced, phase shift and PLL detector), pre emphasis and de-emphasis.

Module 4 **(08 hrs)**

Transmitters and receivers: AM transmitter& receiver: Tuned radio receiver & super heterodyne, limitation of TRF, IF frequency, image signal rejection, selectivity, sensitivity and fidelity, Noise in AM, FM, FM transmitter & receiver: Block diagram of FM transmitter & receiver, AGC, AVC, AFC, Design of FM transmitter and Receiver.

Module 5 **(08 hrs)**

Noise in Communication: Classification of noise, Sources of noise, Noise figure and Noise temperature, Noise bandwidth, Noise figure measurement, Noise in analog modulation, Figure of merit for various AM and FM, effect of noise on AM & FM receivers.

Assessment: Mid-term test, Assignment, Quiz and End semester exam.

List of Experiments:

1. To perform and analyze the experiment of Amplitude Modulation (DSB Signal) & Calculation of parameters.
2. To perform and analyze the experiment of Amplitude Demodulation (DSB Signal).

3. To perform and analyze the experiment of SSB Amplitude Modulation.
4. To perform and analyze the experiment of SSB Amplitude demodulation.
5. To study the effect of Local Oscillator Frequency on reception of signal, in super heterodyne Receiver.
6. To perform and analyze the experiment of AVC and AFC (AGC).
7. To perform and analyze the experiment of Frequency Modulation using Varactor Modulator.
8. To perform and analyze the experiment of Demodulation of FM signal using Ratio Detector.
9. To perform and analyze the experiment of Frequency Modulation using Reactance Modulator.
10. To perform and analyze the experiment of Frequency Demodulation using Foster Seeley Detector.
11. To perform and analyze the experiment of Quadrature Detector.
12. To perform and analyze the experiment of De-tuned Resonant Circuit.
    Also simulate all experiments using TinaPro/E-Sim softwares.

Assessment: Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

Course Outcomes:
Students earning credits will develop ability to:
1. Able to apply knowledge of time domain & frequency domain to solve communication engineering problems.
2. Analyze various AM based modulation schemes for communication systems.
3. Analyze various angle modulation schemes for communication systems and compare the performance of various analog modulation schemes.
4. To design analog communication systems and illustrate the ability to select an appropriate modulation technique.
5. Analyze and compare the noise performance of various analog communication systems.

Text /Reference Books:
1. Singh & Sapre, "Communication Systems", 2nd edition, TMH, 2008.
2. Taub Schilling, "Principles of Communication Systems", 2nd edition, TMH, 2008
3. Simon Haykin, "Communication Systems", 4nd edition, John Wiley & Sons, 2004.
4. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd edition, Pearson Education, 2007.
5. B. P. Lathi, "Modern Analog and Digital Communication Systems", 3nd edition, Oxford University Press, 2007.
6. Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.
7. Martin S. Roden, "Analog and Digital Communication System", 3nd edition, Prentice Hall of India, 2002.

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Department of Electronics & Communication Engineering

PCC-EC403	Linear Integrated Circuit	2L: 1T: 2P (05 hrs)	Credits:04

Recommended Prerequisite: Engineering Mathematics, Electronic Devices.

Course Objective: The objective of this course is to deal with integrated circuits which are imperative and versatile requirement in today's electronics. Operational amplifier is a device which is used in various electronics application, such as summer, integrator and differentiator and so on. This course comprehends the introduction of various IC's such as IC-741, LM321, and IC-555 timer. The course also deals with the analysis and design of circuits including analog signal processing using linear ICs.

Module 1 **(09 hrs)**

Operational Amplifier: Differential amplifier and analysis, Configurations- Dual input balanced output differential amplifier, Dual input Unbalanced output differential amplifier, Single input balanced output differential amplifier, Single input Unbalanced output differential amplifier Introduction of Op-amp, Block diagram, characteristics and equivalent circuits of an ideal Op-amp, Power supply configurations for Op-amp.

Module 2 **(10 hrs)**

Characteristics of Op-amp: Ideal and Practical, Analysis of TL082 datasheet, Op-amp applications: Design of Inverting and non-inverting amplifier configurations, Summing amplifier, Integrators and differentiators, Instrumentation amplifier, Differential input and differential output amplifier, Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Log/Antilog amplifier, Triangular/rectangular wave generator, phase-shift oscillators, Wein bridge oscillator, analog multiplier-MPY634, VCO, Comparator, Zero Crossing Detector, Op-amp as filters.

Module 3 **(07 hrs)**

TIMER: IC-555 Timer concept, Block pin configuration of timer. Design of Monostable, Bistable and Astable Multivibrator using timer 555-IC, Study of LM321 and UA741, Introduction to FM receiver, DTMF Decoder and Receiver.

Module 4 **(08 hrs)**

Voltage Regulator: simple OP-AMP Voltage regulator, Fixed and Adjustable Voltage Regulators, Dual Power supply, Basic Switching Regulator and characteristics of standard regulator ICs such as linear regulator. Switching regulator and low-drop out regulator.

Module 5 **(06 hrs)**

Schmitt Trigger, Voltage limiters, Clipper and clampers circuits, Absolute value output circuit, Peak detector, Sample and hold Circuit, Precision rectifiers, Voltage-to-current converter, Current-to-voltage converter.

Assessment: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

List of Experiments:

1. To determine voltage gain and frequency response of non-inverting amplifiers using IC-741.
2. To determine voltage gain and frequency response of inverting amplifiers using IC-741.
3. To verify the working of Op-amp as Voltage Follower.
4. To design test and built Differentiator using Op-amp.
5. To design test and built Integrator Circuit using Op-amp.
6. To design test and built Instrumentation Amplifier.
7. To design Schmitt Trigger Circuit using IC-741.
8. To design and obtain the frequency response of second order Low Pass Filter (LPF) using (IC-741) Op-amp.
9. To design and obtain the frequency response of second order High Pass Filter (HPF) using (IC-741) Op-amp.
10. To design & implement an Astable Multivibrator using IC-555.
11. To design and obtain the frequency response of second order Band Pass Filter (HPF) using (IC-741) Op-amp.
12. To design and obtain the frequency response of second order Band Reject Filter (HPF) using (IC-741) Op-amp.

Also simulate all experiments using TinaPro/E-Sim softwares.

Assessment: Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Demonstrate and classify various types of feedback amplifier and oscillators in designing of electronic circuits.
2. Demonstrate and classify various types of integrated circuits and their pin configuration and analyze the characteristics of operational Amplifier.
3. Perform and analyze the different mathematical operations using Op-amp.
4. Implementation of IC 555 Timer for different applications.
5. Design voltage regulators for various practical applications.

Text /Reference Books:

1. Ramakant A. Gaikward, “OP- Amp and linear Integrated circuits”, 3rd edition, Pearson Education, 2006.
2. David A. Bell, “Operational Amplifiers & Linear ICs”, 2nd edition, Oxford University Press, 2010.
3. David A. Bell, “Operational Amplifiers & Linear ICs”, 2nd edition, Oxford University Press, 2010.
4. Coughlin Robert F, Driscoll Frederick F., “Operational amplifiers and linear integrated circuits”, 2nd edition, Prentice Hall, New Delhi 1998.
5. David A. Bell, “Operational Amplifiers & Linear ICs”, 2nd edition, Oxford University Press, 2010.

6. B. Somanathan Nair: "Linear Integrated Circuits analysis design and application" Wiley India Pvt. Ltd.
7. Stanley, D. W., "Operational Amplifiers with Linear Integrated Circuits", Charles E. Merrill, Columbus, Ohio, 1985.
8. B. Somanathan Nair: Linear Integrated Circuits analysis design and application Wiley India Pvt. Ltd.
9. Stanley, D. W., "Operational Amplifiers with Linear Integrated Circuits", Charles E. Merrill, Columbus, Ohio, 1985.

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PCC-EC404	Control System	2L: 1T: 0P (03 hrs)	Credits:03

Recommended Prerequisite: Engineering Mathematics, Network Analysis

Course Objective: Control Engineering plays a fundamental role in modern technological systems. The aim of this course is to serve as an introduction to control system analysis and design .A control system consisting of interconnected components is designed to achieve a desired purpose. Modern control engineering practice includes the use of control design strategies for improving manufacturing processes, the efficiency of energy use, advanced automobile control.

Module 1 **(07 hrs)**

Introduction to Control system:

Terminology and classification of control system, examples of control system, Laplace Transform and its application, mathematical modeling of mechanical and electrical systems, differential equations, transfer function, block diagram representation and reduction, signal flow graph techniques.

Feedback characteristics of control systems:

Open loop and closed loop systems, effect of feedback on control system and on external disturbances, linearization effect of feedback, regenerative feedback.

Module 2 **(07 hrs)**

Time response analysis:

Standard test signals, time response of 1^{st} order system, time response of 2^{nd} order system, steady-state errors and error constants, effects of additions of poles and zeros to open loop and closed loop system.

Techniques of stability analysis:

Concept of stability of linear systems, effects of location of poles on stability, necessary conditions for stability, Routh-Hurwitz stability criteria, relative stability analysis, Root Locus concept, Correlation between time and frequency response, Polar plots, Bode Plots, all-pass and minimum-phase systems, log-magnitude versus Phase-Plots, closed-loop frequency response, Nyquist stability criterion, assessment of relative stability using Nyquist plot and Bode plot (phase margin, gain margin and stability).

Module 3 **(09 hrs)**

Frequency response analysis:

Correlation between time and frequency response, Polar plots, Bode Plots, all-pass and minimum-phase systems, log-magnitude versus Phase-Plots, closed-loop frequency response.

Frequency domain stability analysis:

Nyquist stability criterion, assessment of relative stability using Nyquist plot and Bode plot (phase margin, gain margin and stability).

Module 4 **(09 hrs)**

Approaches to system design:

Design problem, types of compensation techniques, design of phase-lag, phase lead and phase lead-lag compensators in time and frequency domain, proportional, derivative, integral and PID compensation.

Module 5 **(08 hrs)**

State space analysis:

State space representation of systems, block diagram for state equation, transfer function decomposition, solution of state equation, transfer matrix, relationship between state equation and transfer function, controllability and observability, application of control system in compensator design and its practical implementation using MATLAB.

Assessment: Midterm test, Assignment, Tutorial, Quiz and End semester exam.

Course Outcomes:

Students earned credits will develop ability to:

1. Provide sound knowledge in the basic concepts of linear control theory and design of control system.
2. Provide adequate knowledge in the time response of systems and steady state error analysis.
3. Basic understanding of issues related to control systems such as modelling, time and frequency responses of dynamical systems, performance specifications.
4. Techniques for determining stability of systems.
5. Design of various controllers and compensators.

Text /Reference Books:

1. I. J. Nagrath and M. Gopal, "Control Systems Engineering", 3rd edition, New Age International Publishers, 2003.
2. Benjamin C. Kuo, "Automatic Control systems", 9th edition, Wiley India Pvt. Ltd, 2014
3. K. Ogata, "Modern Control Engineering", 5th edition, Pearson Education, 2011.
4. B.S. Manke, "linear control system", 1st edition, Khanna Publication, 2005.
5. Norman S. Nise, "Control System Engineering", 5th edition, Wiley India Pvt. Ltd, 2009.
6. R. C. Dorf and R. H. Bishop, "Modern Control Systems", Pearson, 11th edition, 2013.
7. Stefani Shahia, "Design of feedback control system", Oxford University Press, 2002.

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PCC-EC405	Simulation Lab	0L: 0T: 2P (02 hrs)	Credits:01

Recommended Prerequisite: Engineering Mathematics, C Language

Course Objective: The objective of this laboratory is to provide the basic knowledge of MATLAB/MATLAB-Simulink/Scilab software which is used to simulate and implement the trigonometry formula, effect of variation in controller parameter on system response, solve system equations in state-variable form.

List of Experiments:

1. Familiarize with the MATLAB/MATLAB-Simulink/Scilab environment and running some basic commands.
2. To determine transpose, inverse values of given matrix.
3. To perform addition, subtraction, multiplies and divides of binary number of Digital System.
4. To plot Pole Zero Map of a discrete transfer function using MATLAB/MATLAB-Simulink/Scilab simulation.
5. To generate the amplitude modulated wave using MATLAB/MATLAB-Simulink/Scilab simulation.
6. To generate frequency modulated wave using MATLAB/MATLAB-Simulink/Scilab simulation.
7. To generate & analyze CRC code of given data.
8. To evaluate the stability of a system using state space model.
9. To perform operation in image processing for analyzing an image using MATLAB/Scilab.
10. To implement the trigonometry formula using MATLAB/MATLAB-Simulink/Scilab Simulink.

Assessment: Internal viva, Continuous evaluation of experiments, Journal write-up, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Aware of MATLAB/MATLAB-Simulink/Scilab software and perform basic programs.
2. Perform Real time application and know about basic key features of MATLAB/MATLAB-Simulink/Scilab software
3. Develop a program related to control system in MATLAB/MATLAB-Simulink/Scilab software.
4. Develop a program related to data communications in MATLAB/MATLAB-Simulink/Scilab software.
5. Generate and analyze the image using image processing tool box in MATLAB/MATLAB-Simulink/Scilab software.

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Department of Electronics & Communication Engineering

PCC-EC406	**Electronic Workshop-II (Sensor and Automation)**	**0L: 0T: 4P (04 hrs)**	**Credits:02**

Recommended Prerequisite: Electronic devices

Course Objective: The purpose of this lab is to learn, implement and simulation of various electronic circuit for sensors and actuators.

List of Experiments:

1. To design and simulate temperature sensor LM35 circuit.
2. To design and simulate LDR based light intensity detector circuit.
3. To design and simulate IR based black and white line detector circuit.
4. To design and simulate 72xx hall effect sensor circuit.
5. To design and simulate MIC based sound intensity detector circuit.
6. To design and simulate PIR sensor based human detector circuit.
7. To design and simulate CT based current measurement circuit.
8. To design and simulate circuit to control DC fan using LM35 temperature sensor.
9. To design and simulate circuit to control DC bulb using LDR sensor.
10. To design and simulate circuit to measure RPM of DC motor using 72xx sensor.

Simulate of experiments can be done using TinaPro /E-Sim /Tinkercad Softwares.

Assessment: Internal viva, Continuous evolution of experiments, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Analyze the mathematical and physical foundations of electronic sensors and their circuits.
2. Critically evaluate alternate assumptions, approaches, procedures, tradeoffs, and results during electronic sensor circuit designing.
3. Design variety of electronic sensor circuits using simulation software.
4. Demonstrate their design and able to present views.
5. Get skilled and deliver technical presentation.

MC-EC401	Economic Policies in India	1L: 0T: 0P (01 hrs)	Credits:00

Objectives: To introduce the basic understandings of the Indian economy and measurement of various macroeconomic variables to the students.

Module 1 **(7 hrs)**

Basic features and problems of Indian Economy: Nature of Indian Economy, demographic features and Human Resource Development (HDI), Problems of Poverty, Unemployment, Inflation, income inequality, Black money in India.

Module 2 **(7 hrs)**

Sectoral composition of Indian Economy: Issues in Agriculture sector in India ,land reforms Green Revolution and agriculture policies of India , Industrial development , small scale and cottage industries, industrial Policy, Public sector in India, service sector in India.

Module 3 **(7 hrs)**

Economic Policies : Economic Planning in India , Planning commission v/s NITI Aayog, monetary policy in India, Fiscal Policy in India, Centre state Finance Relations, Finance commission in India. LPG policy in India.

Module 4 **(7 hrs)**

External sector in India: India's foreign trade value composition and direction, India Balance of payment since 1991, FDI in India, Impact of Globalization on Indian Economy, WTO and India.

Module 5 **(04 hrs)**

Entrepreneur & Startup: Entrepreneur, entrepreneurship and start-up, characteristics of an entrepreneur, forms of business organization, phases of startup, small medium and large scale enterprise, problems, opportunities, Design Thinking and Ideation. Business model

Course Outcomes:
Students will be able to
1. Develop ideas of the basic characteristics of Indian economy, its potential on natural resources.
2. Understand the importance, causes and impact of population growth and its distribution, translate and relate them with economic development

3. Grasp the importance of planning undertaken by the government of India, have knowledge on the various objectives, failures and achievements as the foundation of the ongoing planning and economic reforms taken by the government.
4. Grasp the important policies of outside India
5. Develop the idea of Entrepreneur, entrepreneurship and start-up.

Text/Reference Books:

1. Dutt Rudder and K.P.M Sunderam, "Indian Economy", S Chand & Co. Ltd. New Delhi.
2. Mishra S.K & V.K Puri, "Indian Economy and –Its development experience", Himalaya Publishing House.
3. Bardhan, P.K, "The Political Economy of Development in India", Oxford University Press, New Delhi. . (9th Edition) (1999), 4. Jalan, B., "India's Economic Policy"- Preparing for the Twenty First Century, Viking, New Delhi.
4. Jhingal M. L., "Economics of development and Planning", 40th edition, Vrinda Publication, 2014.
5. Ahuja H. L., "Advance economic theory", 21th edition, S. Chand Publication, 2017.
6. Riggs, Bedworth and Randhawa, "Engineering Economics", 4th edition, Tata McGraw-Hill, 2004.
7. Chris Gullebeau, "100 Startup", 1th edition, Pan Macmillan Publication, 2012.
8. Peter Thiel, "Zero to One", 2nd edition, Penguin UK publisher, 2014.
9. Rajeev Roy, "Entrepreneurship", 2nd edition, Oxford University Press, 2011.