



5862

Ph.D. ENTRANCE EXAMINATION, OCTOBER 2013

Name of Candidate

Register Number

Answer Booklet Code

Signature of Candidate

Signature of Invigilator

Time : 140 Minutes

Max. Marks : 160

Section – B & C

(This is to test the candidate's capability of defining concepts through short answers.)

Note :

- 1) Answer **any twelve** questions from Section **B** and **one** question from Section **C**.
- 2) In Section **B** **each** question carries **10** marks. Section **C** carries **40** marks.
- 3) In Section **B** an answer should not exceed **100** words. In Section **C** an answer should not exceed **500** words.
- 4) Candidates should **clearly** indicate the **Section, Question Number** and **Question Booklet code** in the answer paper.
- 5) The candidates are **permitted** to answer questions **only** from the subject that comes under the **faculty** in which he/she seeks registration as indicated in the **application** form.

FACULTY OF ENGINEERING

Ph.D. Engineering

1. Mechanical Engineering
 2. Chemical Engineering
 3. Electrical & Electronics Engineering
 4. Architecture & Town Planning
- M.Sc. (Engg.) by Research**
5. Computer Science & Engineering
 6. Electrical & Electronics Engineering



FACULTY OF ENGINEERING

Ph.D. ENGINEERING

1. Mechanical Engineering

Section – B

1. Air having a mass of 1.82 kg at a pressure 0.7 MPa occupies a volume of 0.283 m³. Calculate the final temperature, work done, heat absorbed or rejected if the air expands to 1.415 m³, assuming adiabatic expansion. $C_p = 1.061$ KJ/KgK, $C_v = 0.722$ KJ/KgK.
2. A gas engine working on Otto cycle has a cylinder diameter 177.56 mm and stroke of 254 mm. The clearance volume is 1.5×10^6 mm³. Calculate air standard efficiency.
3. How is calorific value of a fuel determined ? What are higher calorific value and lower calorific value ?
4. Explain why metals are good thermal conductors.
5. Differentiate between absolute humidity and relative humidity. How is relative humidity determined ?
6. Define viscosity, viscosity index and viscoelasticity. Enumerate the methods to determine viscosity. How is viscosity index determined ?
7. With the help of a neat figure explain hydraulic jump.
8. A swimming pool 12 m long and 7 m wide holds water to a depth of 2 m. If the water is discharged through an opening of area 0.2 m² at the bottom of the pool, find the time taken to empty the tank. Take coefficient of discharge for the opening as 0.6.
9. Draw the iron-carbon phase diagram clearly showing the different phases and transition temperatures.
10. What is hardenability and how is hardenability tested ?
11. Write down the 3-Dimensional stress matrix and show the stress components on a figure (3D).
12. Explain the use of strain rosette in determining strain components. What are the different strain rosette configurations used for strain analysis ?



13. List and explain various failure criteria used in engineering design.
14. What are the uses of G and M codes in CNC programming ? Explain word address format used in CNC programming. Write a typical block of CNC program and explain the use of each code.
15. Explain the basic hole system used in metrology. Show the fit H6/p6 pictorially.
16. Differentiate between PERT and CPM used in network analysis. Explain the use of each.

Section – C

1. Roads in the Kerala cities are choked due to excessive vehicle population. How would you conduct a study on Cochin (for example) city's vehicle population, road traffic and road area to evolve methods to alleviate road congestion.
2. Kerala receives copious rainfall during monsoon. But during summer there is acute water shortage. How would you conduct a study to assess the total precipitation during monsoon, how much of this is wasted as run off water, how much is stored in reservoirs and how much of this replenishes the ground water storage ?
3. Your company had developed a new cutting tool material. How would you design an experiment to compare the new tool material with an existing tool material with respect to tool life, surface finish and material removal rate?

2. Chemical Engineering

Section – B

1. A car driving downhill at a speed of 20 m/s was applied brake when it was at a height of 20 m vertically above the bottom of a hill. When the car comes to a halt at the bottom of the hill, how much energy as heat must be dissipated by the brakes, if wind and other frictional effects are neglected ? The car weighed 1200 kg.
2. Gas containing 25% CO, 5% CO₂, 2% O₂ and rest N₂ by volume is burnt with 25% excess air. If the combustion is 90% complete, calculate the composition by volume of the flue gas.
3. 100 m³ of a boiler flue gas has the following composition by volume at N.T .P.
CO₂ – 14.5, O₂ – 3.5, N₂ – 82.0

Calculate the moles and weight percentage of the gases in the mixture.



4. a) An oil of viscosity 50 cp flows through a horizontal pipe of 10 cm diameter and length 1500 m with a flow rate of 5 kg/s. Calculate the pressure drop. Density of the oil may be assumed as 0.89 g/cc.
b) State Newton's law of viscosity. How does a Newtonian fluid differ from a Non-Newtonian fluid ?
5. Compare between steam distillation and vacuum distillation. What are its advantages and disadvantages ?
6. With the help of a neat sketch, explain the working principle of a cyclone separator. What are its advantages and disadvantages ?
7. a) Discuss the principle of operation of a venturimeter.
b) What role does priming play in a centrifugal pump ? Explain the significance of NPSH.
8. Explain the concept of feedback control giving suitable examples.
9. Discuss about the unit processes and the unit operations in chemical Engineering.
10. What are the safety precautions to be taken for transporting and storing hazardous liquids and gases ?
11. a) How do you verify the feasibility of a chemical reaction ? Discuss.
b) Do the presence of inert in the reaction mixture influence the equilibrium conversion ? Explain.
12. Explain in detail the McCabe- Thiele method of design of distillation column for binary systems.
13. What are the characteristics of ideal solutions ? Discuss with suitable examples.
14. a) Why one of the reactant is used in excess while carrying out a reaction and how 'percentage excess' is defined ? Explain with suitable example.
b) What for recycling is used in process industries ? Explain with an example.
15. The vapor pressures of two pure liquids A and B are respectively 100 kPa and 60 kPa at 320 K. The concentration of A in the vapor in equilibrium with a solution of A and B is found to be 50% (mol). Determine the composition of the liquid and the total pressure of the vapor.
16. What are advanced oxidation processes ? How they are useful for waste management ?



Section – C

1. Sketch the pattern of characteristic curves of centrifugal pump and explain the usefulness of such curves.
2. Explain what conductors, semiconductors and insulators are. Which materials are classified as semiconductors and on what basis are they classified as such ?
3. a) Briefly explain the measurement of four primary water quality parameters for defining the water quality.
b) Distinguish between aerobic and anaerobic processes for treatment of waste water.

3. Electrical & Electronics Engineering

Section – B

1. Theoretically explain how a complex quantity can be converted from polar to rectangular and vice versa. Derive the necessary equations.
2. Explain why one of the wattmeter connected to measure 3 phase power using 2 wattmeter methods, reads negative. Give the necessary equations and phasor diagram.
3. Explain a technique used to ensure the elimination of n^{th} harmonics while designing the winding of 3 phase synchronous generators. Explain the demerits of the technique.
4. With circuit diagrams and waveforms, explain the operation of one commutation circuit of SCR.
5. Using the torque slip characteristics of an induction motor, explain how and why certain region is categorised as stable region/unstable region. Why the characteristics take that shape.



6. For what power factor the regulation of a transformer is zero. Derive it from fundamentals.
7. What the delay routines in the context of microprocessors ? Write a simple program in any assembly language to implement square wave generation.
8. With circuit and waveforms, explain continuous conduction and discontinuous conduction mode of operation of boost converter. When it happens. Explain the merits and demerits of each mode.
9. Prove that the Eigen value of a system remain unaltered on linear transformation. Derive the new state space representation after linear transformation.
10. Explain the operation of a unified power flow controller. Compare it with other FACT devices.
11. Suggest a power amplifier which will give maximum efficiency of operation. Draw the waveform and give its demerits.
12. Derive and implement X-OR using minimum number of NAND gates and X-NOR using minimum number of NOR gates.
13. Derive the relation between S and Z plane. Map the Left hand side of the S plane to the Z plane and explain the stability criteria in Z domain.
14. A control system has a forward path transfer function, $G(s) = K / (s^2 + s + 4)$, the feedback path gain is $(1/s)$. Determine the stability of the system using Nyquist plot.
15. Explain the algorithm and compare two different algorithms used for load flow studies in a power system.
16. What are the factors to be considered for defining the tariff system of a generating company ? What are the different tariff schemes available ? Discuss each.



Section – C

1. An automatic speed control system is to be designed to follow a set speed under various load conditions. Choose a typical configuration for the system using a block diagram. Discuss all necessary hardware and software details of such an implementation. 40
2. a) It is required to design a PID controller for an application for which the system transfer function is available. Explain the conventional design approach to tackle the problem. 20
 b) Explain the theory and design aspects of (i) Fuzzy control system (ii) Neural network based control system. (10+10=20)
3. a) Explain the different configurations of active filters used in power quality improvement. What are its merits ? Comment on various control algorithms used in the filters for the purpose. 25
 b) Explain the implementation of power factor correction circuit using power electronic components. Explain its operation, merits and demerits. Brief about the latest trends in this area. 15

4. Architecture & Town Planning

Section – B

1. Give reasons why many of Frank Gehry's works fall within the style of Deconstructivism, which is often referred to as post-structuralist in nature for its ability to go beyond current modalities of structural definition citing the case of Guggenheim Museum in Spain ?
2. Enumerate the emerging challenges of Urban Planning in India.
3. What is meant by surrealism ? Give two examples of surrealist art. Discuss the essential features of Surrealist works.
4. Write an essay on the philosophy of Architect Padmasree Late Sri Laurie Baker. City any two of his famous works.
5. Housing choice is a response to an extremely complex set of economic, social and psychological impulses. Substantiate.
6. What are the factors that affect the overall volume of housing stock and the factors that affect tenure choices ?



7. Discuss the passive energy systems that are found in the traditional buildings of Kerala.
8. What are green buildings ? What is their relevance in today's energy depleting era ?
9. What are the various design techniques adopted in Energy-efficient landscaping ? Distinguish between the embedded energy of materials and constructing the landscape and the energy consumed by the maintenance and operations of a landscape.
10. Waste management is a distinct practice from resource recovery which focuses on delaying the rate of consumption of natural resources. Explain.
11. What is meant by ecological foot print ? How does its efficient use benefit the well being of nature ?
12. Explain how the Sustainable land-management practices such as conservation agriculture, intercropping and sustainable forestry can provide multiple benefits such as reducing erosion, building soil fertility and structure, improving water quality and buffering against drought.
13. Discuss the activities of any one governmental and one nongovernmental organization working in the field of housing in India.
14. Explain how urban planning concerns itself with research and analysis, strategic thinking, architecture, urban design, public consultation, policy recommendations, implementation and management ?
15. Enumerate the ten axioms intended to guide the formulation of city plans and urban designs under intelligent urbanism (PIU- Principles of Intelligent Urbanism).
16. Explain briefly the term Heritage conservation. What is its relevance ? Also explain the process involved in the heritage conservation of a heritage core.

Section – C

1. Explain the parametric and non parametric methods used in statistical researchers.
2. How are research proposals structured ? What is the importance of a hypothesis in research ? Also define a null hypothesis.
3. What is the importance of data collection in research ? Explain the various methods and tools used in data collection.



M.Sc. (Engineering) by Research
5. Computer Science & Engineering

Section – B

1. Suppose program P1 requires $T_1(n) = n^4$ operations and P2 requires $T_2(n) = n^n$. Suppose that your machine executes 10^9 operations per second. If $n = 10000$. What is the running time of these programs ? If you want to run your program in 12 hours, how big can your input be ? For which input size do the programs have same running times ?
2. Consider the problem of scheduling n jobs of known durations t_1, t_2, \dots, t_n for execution by a single processor. The jobs can be executed in any order, one job at a time. You want to find a schedule that minimizes the total time spent by all the jobs in the system. (The time spent by one job in the system is the sum of the time spent by this job in waiting plus the time spent on its execution.) Design a greedy algorithm for this problem. Does the greedy algorithm always yield an optimal solution ? Justify your answer. Suggest a suitable problem solving approach to solve this problem.
3. Suggest a data structure for representing a subset S of integers from 1 to n . Following operations on the set S are to be performed in a constant time (independent of cardinality of S)
 - 1) MEMBER(x) : Check whether x is in the set or not
 - 2) FIND-ONE(S) : If S is not empty, return one arbitrary element of the set S
 - 3) ADD(x) : Add integer x to set S
 - 4) DELETE(x) : Delete integer x from SGive pictorial examples of your data structure. Give pseudo-codes for those operations. You can assume that the data structures has been suitably initialized. Clearly state your assumptions regarding initialization.
4. Design a 4 bit carry look-ahead adder. Show mathematically this design provides substantial speed improvements over ripple carry adder.
5. Explain the advantages of using scripting for research. List five scripting languages widely used for the research and development applications.



6. Write C code snippets for the following :
 - a) to swap two variables in four different ways
 - b) to multiply any number by 9 in a faster manner.
7. State travelling salesman problem. What is the complexity of this problem, if solved using brute-force approach ? Suggest an alternative approach for solving this problem in an efficient manner. If you are interested to find an approximate minimum cost of tour, what approximation algorithm could be used to find the solution ?
8. Construct LALR set of items for the grammar $S \rightarrow SS+ \mid SS^* \mid a$.
9. Three points in the plane are given, not all on the same straight line. How many lines can be drawn which are equivalent from these points ?
10. A group of 11 researchers are working on a secret project, the materials of which are kept in a safe. They want to be able to open the safe only when a majority of the group is present. Therefore the safe is provided with a number of different locks, and each researcher is given the keys to certain of these locks. How many locks are required ? How many keys must each researcher have ?
11. Explain the differences between soft and hard computing techniques. List 10 soft computing techniques widely used in research and development.
12. Discuss the advantages and disadvantages of using the following interconnection networks in the design of a shared memory system.
 - a) Bus;
 - b) Crossbar switch;
 - c) Multistage network.
13. Design a DFA to accept the language L where
$$L = \{w \mid w \text{ has both an even number of zeros and even number of ones}\}$$
14. Explain role of software testing frameworks and automated scripts in research and development.
15. There are several network layer models proposed in the OSI model. List all of them. Explain the differences between them.



16. Write short note on the following :

- a) Big data analytics
- b) Cloud computing
- c) Open source support for research and development
- d) Computational Intelligence.

Section – C

1. Discuss the latest advances in computing and communications. Discuss potential research issues in the following areas :
 - a) Bio-informatics and Bio-computing
 - b) Cyber forensics
 - c) Ad hoc networks
 - d) Cloud, cluster and grid computing.
2. Current imaging and video applications, such as medical imaging, teleradiology, space imaging, multimedia, and video on demand, involve massive amounts of data which have pushed the storage and transmission technologies to their limits and beyond. One approach to deal with the massive amounts of data is data compression. Explain the various aspects of data compression and novel compression techniques are being developed. Explain the research challenges for data compression in the field of medical applications, ad hoc networks and data warehouses.
3. Discuss one research problem of your interest in the field of computer science and engineering. What do you aspire when joining for the research programme in this area ? Suggest some methods to pick right research problems from this area.

6. Electrical and Electronics Engineering

Section – B

1. What are the theoretical conditions to be satisfied for converting an amplifier into an oscillator. Explain such an oscillator in detail.
2. With a block diagram, explain the operation of a digital energy meter. Explain the theory involved.



3. Prove analytically that the balanced 3 phase supply given to the stator winding of a 3 phase cage induction motor develops a rotating magnetic field. Also explain the working of an induction motor.
4. What is the essential difference between the emf and mmf methods of predetermining the regulation of an alternator. Briefly explain each method.
5. Explain the 2 reaction theory referred to salient pole alternator.
6. The V curve of a synchronous machine moves up/down when the power supplied/delivered by the machine changes. Explain the reason when the machine is (a) motoring, (b) generating. Draw the curves.
7. Distinguish between hardware interrupt, software interrupt, Non maskable interrupts, vectored interrupts etc in the context of microprocessors. Explain the steps involved and timing diagram of a microprocessor, in serving an interrupt.
8. How a heat sink is selected in a power electronic circuit design ? Draw the thermal equivalent circuit and obtain the mathematical equations.
9. Design a power electronic circuit to obtain a variable voltage supply of 5 to 15 V, when a fixed DC supply of 10 V is available. Propose a circuit and discuss about the component selection for the circuit.
10. An assembly language programme is to be written for finding the square root of a number. Develop an algorithm and write the program using the mnemonics of any assembly language.
11. Suggest a second order filter circuit for attenuating signals above that of a threshold frequency. Explain the design of the circuit and obtain the component value for an assumed threshold frequency.



12. A fancy lighting system is to be designed with 5 LEDs arranged in the periphery of a circle. The LEDs brightens one after the other in a continuous manner, once the power is switched ON. Suggest a circuit and explain its operation.
13. A sampled data system having a Z transfer function is given. It is required to use Routh-Hurwitz Criteria for checking the stability of the system. Suggest a method and explain it.
14. A control system has an open loop transfer function of $K/s(s^2+s+4)$. Determine the stability of the system using a frequency domain technique.
15. What is meant by characteristic impedance of a power system network. Explain its significance and use.
16. Write the algorithm of fast decoupled load flow study. Compare it with other methods.

Section – C

1. Give a generalised block diagram of an automatic control system and explain the role of each part. It is required to control the water level of a tank within a lower and upper limit using a microprocessor/Microcontroller. Give the circuit Layout and algorithm and the design steps involved. **40**
2. What are lag and lead compensators. Explain their selection for an application. Explain the design steps of both using a time domain approach, assuming a system transfer function and required specifications. **40**



3. a) State and explain the aim, mathematical problem formulation and solution methods of a power system economical load dispatch problem. **15**
- b) What is meant by load flow analysis ? What are the different techniques used ? Compare them. Explain the algorithm and flow chart of 2 of the load flow methods. **25**
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