

ELECTRICAL ENGINEERING - II (Optional)

Standard : Degree

Total Marks : 200

Nature : Conventional

Duration : 3 Hours

Note :

- (i) Answers must be written in **English**.
- (ii) Question No. 1 is **Compulsory**. Of the remaining questions, attempt **any four** selecting one question from **each section**.
- (iii) Figures to the **RIGHT** indicate marks of the respective question.
- (iv) Use of log table, Non-Programmable calculator is permitted, but any other Table/Code/Reference book are not permitted.
- (v) Make suitable assumptions, wherever be necessary and state the same.
- (vi) Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.
- (vii) Credit will be given for orderly, concise and effective writing.
- (viii) Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he will be penalised.

1. Answer any four of the following :

- (a) What are the main differences between a transistor and a thyristor ? Draw V - I characteristics of SCR, Diac and Triac. **10**
- (b) Draw a block diagram representation of Pulse Code Modulation (PCM). What are the advantages of PCM ? **10**
- (c) Explain briefly the connection between Fourier Series and Fourier Transforms. **10**
- (d) Write the complete equation for power obtained from wind turbine generator in terms of input wind velocity. Explain all the terms in equation. **10**
- (e) Enumerate any five salient features of the Indian Electricity Act, 2003. **10**

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SECTION - A

2. Answer the following sub-questions :

- (a) (i) Find the number of SCRs, each with a rating of 500 V, 75 A, required in a branch of a series - parallel combination for a circuit with a total voltage and current rating of 7.5 kV and 1 kA. Assume derating of 14% for each SCR. 5
- (ii) What is the number of data and address bits in micro-processor 8085 ? Which are the three buses in 8085 ? 5
- (b) A single phase bridge circuit is shown in Fig. 2 (b), with RMS voltage of 230 V A.C. and output load current of 5 A is produced by rectification of firing angle of SCR is maintained at 45 degrees. 15

Calculate the D.C. output voltage and active and reactive power input. Repeat the above in the presence of a free wheeling diode. Now if SCR 3 is open circuited, calculate the D.C. output voltage and current using free wheeling diode.

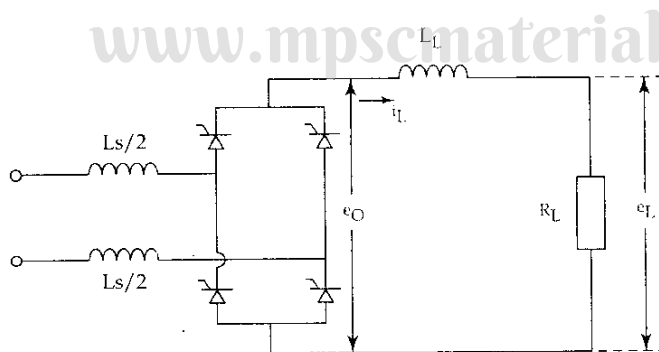


Fig. 2 (b)

- (c) Name different addressing modes for 8051 micro-controller. Explain each with example. 15

Given the co-ordinates of two points X (x_1, x_2, x_3) and Y (y_1, y_2, y_3), write a sub-routine to compute distance between these points and the direction cosines of the vector XY.

3. Answer the following sub-questions :

- (a) (i) Calculate the values of L & C required to filter the RF interference caused by SCR with a load resistance of 150Ω , if the interference occurs at 100 kHz. 5
- (ii) Give the function of each of the following commands for 8085 micro-processor. 5
MOV, LDAX, RLC, CMP, ADI.
- (b) A 220 V, 1500 rpm, 10 A, separately excited D.C. motor has an armature resistance of 1 ohm. It is fed from a single phase fully controlled bridge rectifier with an A.C. source voltage of 230 V (rms), 50 Hz. Assuming continuous load current, compute motor speed at firing angle of 30° and torque of 5 N-m. Also find torque developed at firing angle of 45° and speed of 1000 rpm. 15
- (c) Eight numbers of 8 bit data are stored from 2501 H to 2508 H memory locations. Develop programs in 8085 Assembly language to determine 15
- (i) largest element in the block of data.
- (ii) smallest element ($\geq 00H$) in the same block of data.
Store the results in 2450 H and 2451 H respectively. Give suitable comments in your program.

SECTION - B

4. (a) In an Amplitude Modulation (AM) system, modulating signal is sinusoidal with frequency of f_m Hz. If 80% of modulation is used, determine the ratio of total side band power in the modulated signal. 15
A PCM system uses a uniform quantization followed by a 7 bit binary encoder. The bit rate of the system is 50 Mbps. What is the maximum message bandwidth for which the system operates satisfactorily ?
- (b) Define Time and Frequency Division Multiplexing ? Describe TDM in brief. What is FDMA ? Which type of multiplexing, do modern telephones use ? 15
- (c) What is an optical fibre ? Describe its basic principle of operation. 10

P.T.O.

5. Answer the following sub-questions :

- (a) What are the merits and demerits of AM over FM ? Consider a carrier wave form $10 \cos w_c t$ and modulating signal of $3 \cos w_m t$, with $f_c = 100$ kHz and $f_m = 4$ kHz. Calculate the modulation index and channel bandwidth for amplitude and frequency modulation. Assume sensitivity of frequency modulator to be 5 kHz/volt. **15**
- (b) What is refractive index ? Express it in terms of permittivity and permeability of medium. Given the permeability as $4\pi \times 10^{-7}$, find permittivity for vacuum. If the refractive index of glass is 1.5, then what is the ratio of speed of light in glass to that in vacuum ? **15**
- (c) What is the critical angle ? For Lucite, if the refractive index is 1.5, what is the critical angle ? What is the application of critical angle in jewellery industry ? **10**

SECTION - C

6. (a) (i) Explain the staircase waveform shown in fig. 6(a) in terms of step function. **5**

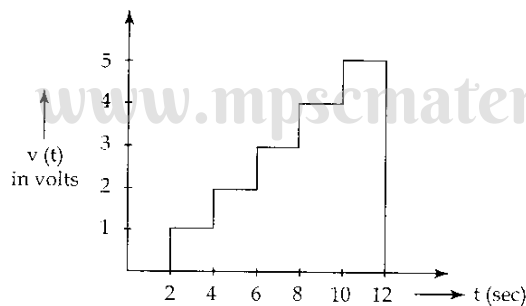


Fig. 6 (a)

- (ii) Find the current $i(t)$ in a L.T.I. system represented by a series R-L-C circuit **5**
with $R = 4$ ohms, $L = 1$ Henry and $C = \frac{1}{3}$ Farad when an impulse voltage of magnitude 2 units and shifted late by 1 second is applied as equivalent driving force.
- (b) What is convolution integral ? Discuss its application to circuit theory. Given the impulse response of a system is e^{-t} , obtain the system response for an input $\sin \omega t$ using the convolution method. **10**

Marks

- (c) Compare advantages and disadvantages of digital and analog filters. What are the typical requirements in the design of a digital filter? Write z-domain transfer function of a typical linear digital filter. Also, write the resultant linear difference equation for a filter with transfer function : 10

$$H(z) = \frac{(z+1)^2}{(z-\frac{1}{2})(z+\frac{3}{4})}$$

- (d) What is multirate signal processing? The multirate filter design method is used for which type of filter design? Why? What are the basic processes involved in it? 10
7. (a) Write the governing differential equation for the translational system shown in fig.7 (a). Also draw the equivalent electrical circuit. 10

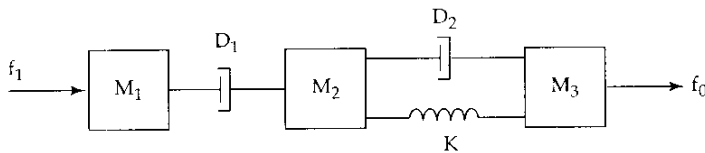


Fig. 7 (a)

- (b) For the RLC circuit shown in fig.7(b), $I_s = 10A$, $R = 1 \text{ ohm}$, $L = 1 \text{ Henry}$, $C = 1 \text{ microfarad}$, $i_L(0^-) = 0$. Determine $v(0^+)$, $\frac{dv}{dt}(0^+)$, $\frac{d^2v}{dt^2}(0^+)$, after the switch is closed at $t=0$. 10

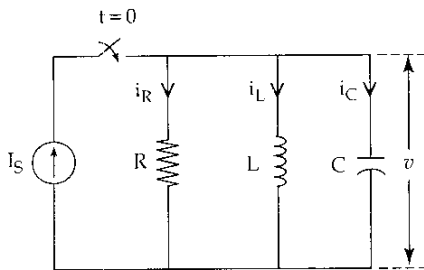


Fig. 7 (b)

- (c) Which are the four main categories into which quantization effects in digital filters can be classified? Define FIR and IIR filters and write their transfer functions. Compare them on the basis of stability, efficiency and phase. 10
- (d) Explain decimation operation in the multirate filter design. 10

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SECTION - D

8. (a) (i) What is the significance of Energy Management today ? 5
- (ii) What are the difficulties with conventional energy sources ? 5
- (iii) Draw basic block diagram of a solar photo-voltaic system feeding an isolated load (like street light). What are the major draw-backs of the system ? 5
- (b) For the system shown in fig. 8(b), determine the per unit values of all parameters for a reference base of (i) 100 MVA and voltage 66kV (ii) 100MVA and voltage 110kV 15

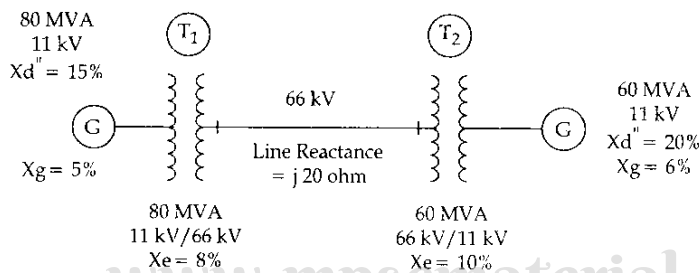


Fig. 8 (b)

- (c) A 3 phase fault occurs at point 'F' in power system shown in fig. 8(c). Find the critical clearing angle for clearing the fault, with simultaneous opening of the breakers on either side of fault, on faulted line. The generator is delivering 1p.u. power during pre-fault conditions. 10

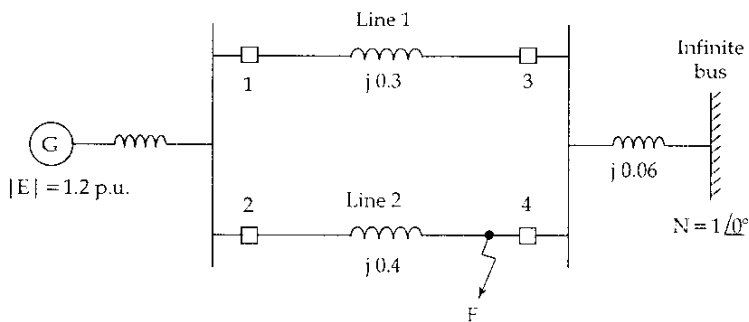


Fig. 8 (c)

Marks

9. (a) Consider an ideal wind turbine generator situated at a place, having the following hourly wind speed profile in kmph. 15

Hours	00	01	02	03	04	05	07	08
Wind speed	33.7	34.3	34	33.5	32.7	32.7	32.1	33.1
Hours	09	10	11	12	13	14	16	17
Wind speed	34	34.6	35	36	36.9	37.6	37.5	36.8
Hours	18	19	20	21	22	23		
Wind speed	35.6	36	35	35.2	34.9	33.5		

Assuming same regime throughout the year, calculate energy generated per unit swept area by the blades in a year. If the rated wind speed of machine is 12 m/sec, find the annual capacity factor. Take air density as 1.164 kg/m^3 .

What are the three major issues involved in grid integration of wind power ?
What is 'penetration factor' ?

- (b) Two generators rated 11 kV, 5 MVA having 20% reactance are interconnected by a 100 km long transmission line. Reactance of line is 0.12 ohm/km. The transformers are rated 7500 kVA, 11 kV/110 kV and have 8% reactance. A 3 phase fault occurs at a distance of 30 km from one end of the line, when the system is on no load, but at rated voltage. Calculate fault MVA and fault current. 15
- (c) (i) A loss free alternator supplies 50 MW to an infinite bus, the steady state stability limit being 100 MW. Determine whether the alternator will remain stable, if input to prime-mover is abruptly increased by 40 MW. 5
- (ii) A factory draws 100 kW at 0.7 p.f. lagging from 3-phase, 11 kV supply. It is desired to raise p.f. to 0.95 lagging, using series capacitors. Calculate the rating of capacitor required. 5

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