Code No: R161214 **R16** SET - 1

I B. Tech II Semester Regular/Supplementary Examinations, April/May - 2019
ELECTRICAL AND MECHANICAL TECHNOLOGY
(Com. to ECE, EIE, ECom E)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is Compulsory
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) What is voltage regulation of a transformer? (2M)

   b) What for field coils are provided in a dc machine? (2M)

   c) List the major parts of an Induction motor. (2M)

   d) A moving-iron instrument gives full-scale deflection with 200 V. It has a coil of 20,000 turns and a resistance of 2000 Ω. If the instrument is used as an ammeter to give full-scale deflection at 10 A, calculate the number of turns required. (2M)

   e) What are the different modes of heat transfer? Explain. (2M)

   f) Write soldering operation with neat sketch (2M)

   g) Define indicated thermal efficiency of an IC Engine. (2M)

PART -B

2. a) What are the different types of dc generators according to the ways in which field are excited? Show the connection diagram of each type. (7M)

   b) A 240 V shunt motor has an armature resistance of 0.2 Ω and takes armature current of 20 A on full-load. The electromagnetic torque being constant, by how much must the flux be reduced to increase the speed by 40%? (7M)

3. a) Discuss synchronous impedance method for calculating the voltage regulation of a synchronous generator. (7M)

   b) A 4-pole, three-phase induction motor operates from a supply whose frequency is 50 Hz. Calculate (i) the speed at which the magnetic field of the stator is rotating (ii) the speed of the rotor when the slip is 0.02 (iii) the frequency of rotor currents when the slip is 0.04 (iv) the frequency of the rotor currents at standstill (7M)

4. a) With neat schematic diagram explain the working of an attraction type moving iron instrument. (7M)

   b) Sketch the construction of a CRO. Briefly explain. (7M)

5. a) With neat sketch explain different types of fins. (6M)

   b) One side of a plane wall is maintained at 100^0 C, while the other side is exposed to a convection environment having T=10^0 C and h= 11 W /m^2 K The wall has k=1.6 W/m K and is 40 cm thick. Calculate the heat transfer rate through the wall. (8M)
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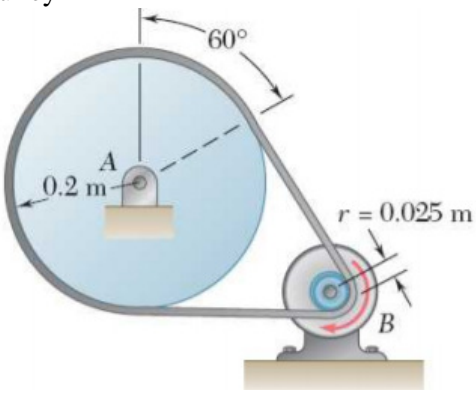
6. a) A flat belt connects pulley A to pulley B. The coefficients of friction are $\mu_s = 0.25$ and $\mu_k = 0.20$ between both pulleys and the belt. Knowing that the maximum allowable tension in the belt is 600 N, determine the largest torque which can be exerted by the belt on pulley A (7M)



b) Briefly Explain the following machining processes on a lathe with the help of neat sketches: (i) Knurling (ii) Facing (iii) Drilling. (7M)

7. a) A four cylinder, four stroke petrol engine has a bore of 57 mm and stroke of 90 mm. Its rated speed is 2800 rpm, torque is 55.2 Nm. The fuel consumption is 6.74 liters/hour. The density of the petrol is 735 kg/m^3 and petrol has a calorific value of 44200 kJ/kg. Calculate brake power, brake thermal efficiency and brake specific fuel consumption. (7M)

b) Differentiate two stroke engines from four stroke engines. (7M)

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PART –A

1. a) Even at no-load, a transformer draws current from the mains. Why? (2M)

   b) Give two applications of series motor and shunt motor each. (2M)

   c) A 230 V, 50 Hz single phase energy meter has a constant of 1200 rev/kWh. Determine the speed of the disc in r.p.m. for current of 10 A at a p.f. of 0.8 lagging. (2M)

   d) What do you understand by synchronous speed? (2M)

   e) What are the basic components of an IC engine (2M)

   f) What is the significance of the heat transfer? (2M)

   g) How do you specify a lathe? (2M)

PART -B

2. a) Explain the principle of torque production in a dc motor and derive an expression for it. (7M)

   b) What is voltage regulation? Develop an expression for calculating the voltage regulation of a two-winding transformer. (7M)

3. a) Derive the equation for torque developed by an induction motor and draw its torque-slip curve. (7M)

   b) A 3-phase, star-connected, 50 Hz alternator has 96 conductors per phase and a flux/pole 0.1 Wb. The alternator winding has a synchronous reactance of 5 Ω/phase and a negligible resistance. The distribution factor for the stator winding is 0.96. Calculate the terminal voltage when three non-inductive resistors, of 10 Ω/phase, are connected in star across the terminals. (7M)

4. a) Differentiate between deflecting torque and controlling torque (7M)

   b) With neat schematic explain the working of an repulsion type moving iron instrument. (7M)

5. a) Explain briefly about different modes of heat transfer with examples. (7M)

   b) Two large plates are maintained at a temperature of 900 K and 500 K respectively. Each plate has area of 6 m^2 . Compare the net heat exchange between the plates for the following cases. (i) Both plates are black (ii) Plates have an emissivity of 0.5. (7M)
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6. a) A flat belt, 8 mm thick and 100 mm wide transmits power between two pulleys, running at 1600 m/min. The mass of the belt is 0.9 Kg/m length. The angle of lap in the smaller pulley is 165^{o} and coefficient of friction between the belt and pulley is 0.3. If the maximum permissible stress in the belt is 2 MN/m^2, find (i) maximum power transmitted (ii) initial tension in the belt. (7M)

   b) Explain the following operations with neat sketch. (7M)
   (i)Forging (ii) Rolling (iii) Extrusion.

7. a) A four stroke cycle gas engine working on constant volume cycle develops 11 kW at 250 rpm. The following data refers to the engine. The diameter of the cylinder is 24 cm, stroke length is 40 cm, clearance volume is 4500 c.c. Average explosions per minute are 80. The average mean effective pressure during firing stroke is 7 bar. The gas fuel consumption rate is 15 cubic meter / hour at a pressure of 770 mm of Hg. and C.V. of gas fuel is 21 MJ/m^3. Find: (7M)
   (i) Indicate power (ii) Mechanical efficiency (iii) Brake thermal efficiency.

   b) With neat sketch, explain the working of 2- stroke petrol engine. (7M)

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PART –A

1. a) The power factor of a transformer at no-load is very low. Why? (2M)
   b) Why is a commutator needed in dc motors? (2M)
   c) What are the advantages of a PMMC instrument? (2M)
   d) What is slip of an induction motor? (2M)
   e) What are the laws of thermodynamics. (2M)
   f) Define fin efficiency. (2M)
   g) Discuss relative merits and demerits of belt drive. (2M)

PART -B

2. a) What are the losses that occur in a transformer? Write the condition for maximum efficiency. (7M)
   b) A 400 V dc shunt motor has an armature and shunt-filed resistance of 0.3 and 200 Ω respectively. It takes full-load current of 50 A and runs at 1000 rpm. Calculate the speed of the motor when a 100 Ω resistor is connected in series with the field winding, the load torque remaining same. Assume that field flux is proportional to the field current. (7M)

3. a) With the help of a neat schematic diagram explain the basic operation of an alternator. (7M)
   b) A three-phase, 50 Hz, 4-pole induction motor is running with a slip of 4%. Calculate (i) the speed of the rotating field relative to the stator winding (7M)
   (ii) the motor speed
   (iii) the frequency of emf induced in the rotor
   (iv) the speed of rotation of rotor mmf relative to rotor winding
   (v) the speed of rotation of rotor mmf relative to stator winding

4. a) With the help of neat diagrams explain the working principle of PMMC type of instrument. (7M)
   b) Describe methods of extension of range of an ammeter and a voltmeter. (7M)

5. a) Define natural convection and forced convection. (7M)
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b) A motor body is 360 mm in diameter (outside) and 240 mm long. Its surface temperature should not exceed 55^{o}C when dissipating 340W. Longitudinal fins of 15 mm thickness and 40 mm height are proposed. The convection coefficient is 40W/m^{2o}C. determine the number of fins required. Atmospheric temperature is 30^{o}C. thermal conductivity = 40 W/m^{o}C. (7M)

6. a) What machining operations can be performed on a center lathe? Explain in detail. (7M)

b) Classify different types of gears. (7M)

7. a) Classify the Internal Combustion engine with respect to: (i) Cycle of operation; (ii) Type of Ignition; (iii) Types of fuels used; (iv) Type of cooling. (7M)

b) A petrol engine uses a fuel of calorific value of 42000 kJ/kg and has a specific gravity of 0.75. The brake thermal efficiency is 24% and mechanical efficiency is 80%. If the engine develops a brake power of 29.44 kW, calculate (i) Volume of fuel consumed per second; (ii) Indicated thermal efficiency (7M)

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PART –A

1. a) Why does voltage drop in a transformer? (2M)
   b) Why is the starting current high in dc motor? (2M)
   c) What is an indicting instrument? (2M)
   d) Name the major parts of an alternator. (2M)
   e) Define fin effectiveness. (2M)
   f) List out various renewable energy sources. (2M)
   g) With a neat sketch explain the Oxy-acetylene Welding method. (2M)

PART -B

2. a) Explain the principle of operation of a single-phase transformer. Derive its emf equation. (7M)
   b) A 4-pole lap wound d.c. shunt generator has a useful flux per pole of 0.07wb, the armature winding consists of 220 turns each of 0.004Ω resistance. Calculate the terminal voltage when running at 900 r.p.m. and the armature current is 50 A. (7M)

3. a) Describe the principle of operation of a three-phase induction motor. Explain why the rotor is forced to rotate in the direction of rotating magnetic field. (7M)
   b) A 3.3 kV, 3-phase star-connected alternator has a full-load current of 100 A. Under short-circuit condition it takes 5 A field current to produce full-load short-circuit current. The e.m.f. on open circuit for the same excitation is 900 V (line-to-line). The armature resistance is 0.9 Ω/phase. Determine synchronous reactance per phase and regulation for (i) 0.8 p.f. lagging, (ii) 0.8 p.f. leading. (7M)

4. a) What are the different methods of obtaining controlling torque in an indicating instrument? (7M)
   b) With the help of a neat schematic explain the operation of a single-phase induction watthour meter. (7M)

5. a) Define absorptivity, reflectivity and transmissivity. (7M)
   b) State the basic laws of radiation. (7M)
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6. a) What do you mean by open belt drive? Find the length of the belt in open belt drive. (7M)

   b) Explain with sketch any three types of rolling mill. (7M)

7. a) During testing of single cylinder two stroke petrol engine following data is obtained, Brake torque 640 NM, Cylinder diameter 21cm, speed 350 rpm, stroke 28cm, mean effective pressure 5.6 bar, oil consumption 8.16 Kg/hr, Calorific value= 42705 KJ/Kg. Determine Mechanical efficiency, Indicated thermal Efficiency, Brake thermal efficiency and Brake specific fuel consumption. (7M)

   b) What are the basic IC engine components and explain their function of each. (7M)